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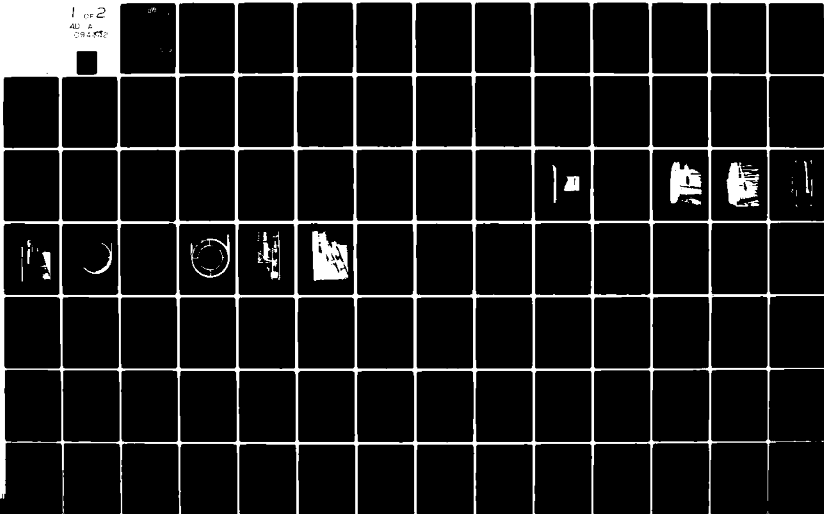

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ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRESENTING THE R/V ATHENA WITH AND WITHOUT THE BASS DYNAMOMETER BOAT

DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Maryland 20084

ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRESENTING THE R/V ATHENA WITH AND WITHOUT THE BASS DYNAMOMETER BOAT.

by

Rae B. Hurwitz and L. Bruce Crook

Ship Performance Department
Departmental Report

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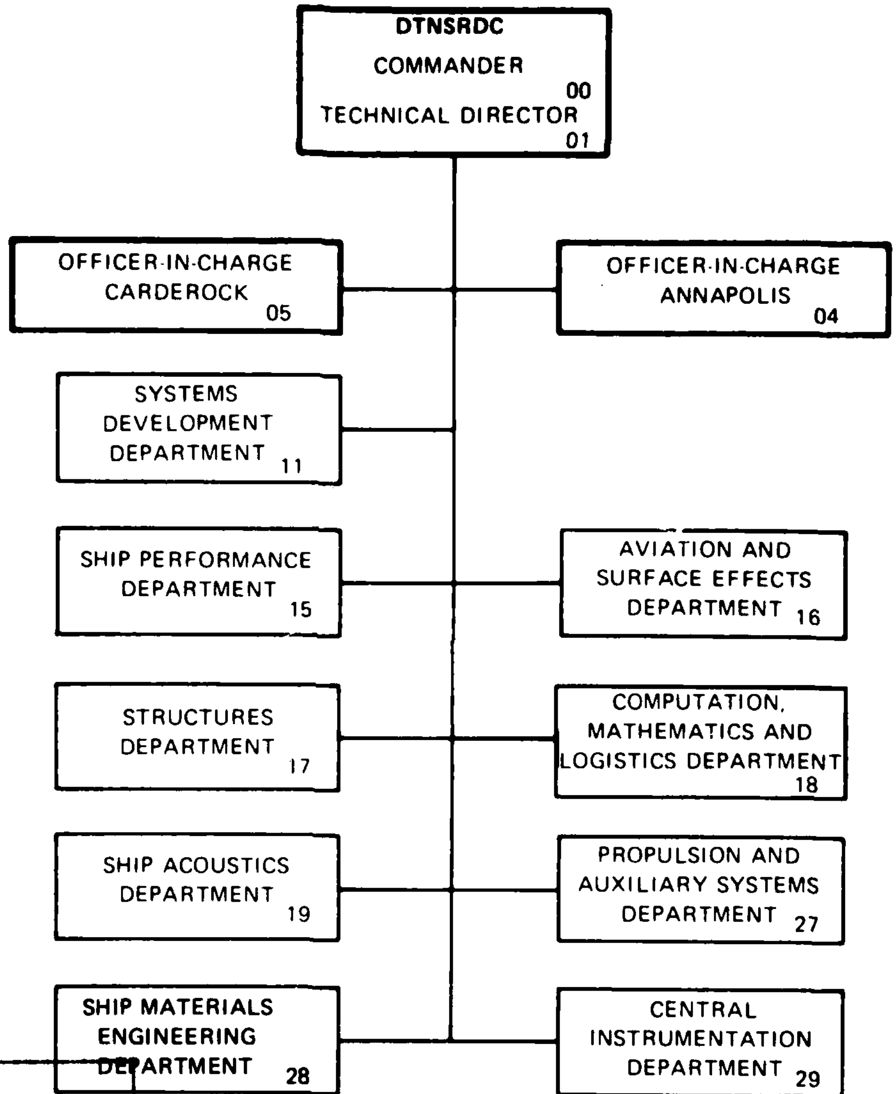

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This report describes a series of model experiments conducted as part of the overall project of the David Taylor Naval Ship Research and Development Center (DTNSRDC) to adapt controllable pitch propellers to the needs of high speed combatant ships. The first set of experiments was conducted on a model of the R/V ATHENA with and without the port propeller operating. The second set repeated the first, except that the Bass Dynamometer Boat was mounted aft of the model. The third set was a series of idealized wake (over)

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distribution experiments, in which the model was removed and the pitot rake was mounted upstream of the Bass Boat. The effect of an operating port propeller on the mean starboard wake distribution and the harmonic content of the wake was small. The presence of the Bass Boat behind the ATHENA model, however, affects both the mean values and the harmonic content of the wake. Finally, one idealized mean wake distribution was shown to be weakly dependent on speed, and the harmonic content of wakes at two different speeds differed by less than three percent.

9. SHIP PERFORMANCE DEPARTMENT

10. Work Unit Number 1524-641

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NOTATION

CONVENTIONAL SYMBOL	SYMBOL APPEARING ON PLOTS	DEFINITION
A_N	COS COEF	The cosine coefficient of the N^{th} harmonic*
B_N	SIN COEF	The sine coefficient of the N^{th} harmonic*
D	---	Propeller diameter
J_V	---	Apparent advance coefficient $J_V = \frac{V}{nD}$ (dimensionless)
N	N	Harmonic number
n	---	Propeller revolutions
r/R or x	Radius or RAD.	Distance (r) from the propeller axis expressed as a ratio of the propeller radius (R)
V	V	Actual model or ship velocity
$V_b(x,\theta)$	---	Resultant inflow velocity to blade for a given point
$\overline{V}_b(x)$	---	Mean resultant inflow velocity to blade for a given radius
$V_r(x,\theta)$	VR	Radial component of the fluid velocity for a given point (positive toward the shaft centerline)
$\overline{V}_r(x)$	---	Mean radial velocity component for a given radius
$V_r(x,\theta)/V$	VR/V	Radial velocity component ratio for a given point
$\overline{V}_r(x)/V$	VRBAR	Mean radial velocity component ratio for a given radius
$V_t(x,\theta)$	VT	Tangential component of the fluid velocity for a given point (positive in a counterclockwise direction looking forward)

*See footnote on the following page

NOTATION (Continued)

$\bar{V}_t(x)$	---	Mean tangential velocity component for a given radius
$V_t(x,\theta)/V$	VT/V	Tangential velocity component ratio for a given point
$\bar{V}_t(x)/V$	VTBAR	Mean tangential velocity component ratio for a given radius
$(\tilde{V}_t(x)/V)_N$	AMPLITUDE	Amplitude (B_N for single screw symmetric; C_N otherwise) of Nth harmonic of the tangential velocity component ratio for a given radius*
$V_x(x,\theta)$	VX	Longitudinal (normal to the plane of survey) component of the fluid velocity for a given point (positive in the astern direction)
$\bar{V}_x(x)$	---	Mean longitudinal velocity component for a given radius
$V_x(x,\theta)/V$	VX/V	Longitudinal velocity component ratio for a given point
$\bar{V}_x(x)/V$	VXBAR	Mean longitudinal velocity component ratio for a given radius
$(\tilde{V}_x(x)/V)_N$	AMPLITUDE	Amplitude (A_N for single screw symmetric; C_N otherwise) of Nth harmonic of the longitudinal velocity component ratio for a given radius*
ϕ_N	PHASE ANGLE	Phase Angle of Nth harmonic*

*The harmonic amplitudes of any circumferential velocity distribution $f(\theta)$ are the coefficients of the Fourier Series:

$$f(\theta) = A_o + \sum_{N=1}^{N} A_N \cos(N\theta) + \sum_{N=1}^{N} B_N \sin(N\theta)$$

$$= A_o + \sum_{N=1}^{N} C_N \sin(N\theta + \phi_N)$$

NOTATION (Continued)

$1-w(x)$	1-WX	Volumetric mean velocity ratio from the hub to a given radius

$$1-w(r/R) = \left[\frac{2 \cdot \int_{r_{hub}/R}^{r/R} (\bar{V}_{x_c}(x)/V) \cdot x \cdot dx}{(r/R)^2 - (r_{hub}/R)^2} \right]$$

where $$\bar{V}_{x_c}(x)/V = \int_0^{2\pi} \left[\frac{V_{x_c}(x,\theta)}{2\pi V} \right] d\theta$$

and $$V_{x_c}(x,\theta)/V) = (V_x(x,\theta)/V) - (V_t(x,\theta)/V) \tan(\beta(x,\theta))$$

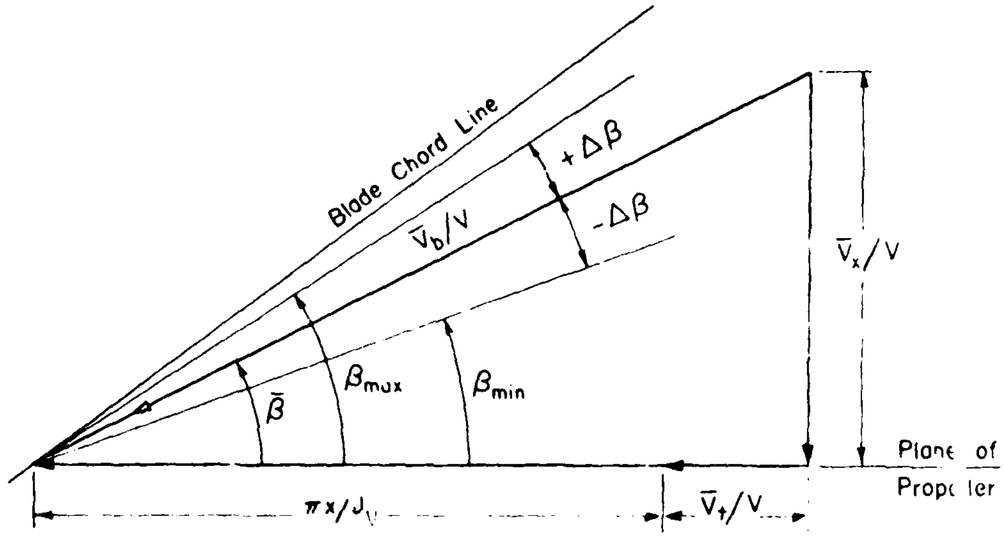
$1-w_v(x)$	1-WVX	Volumetric mean velocity ratio from the hub to a given radius (without the tangential velocity correction)

$$1-w(r/R) = \left[\frac{2 \cdot \int_{r_{hub}/R}^{r/R} (\bar{V}_x(x)/V) \cdot x \cdot dx}{(r/R)^2 - (r_{hub}/R)^2} \right]$$

$\beta(x,\theta)$	---	Advance angle in degrees for a given point
$\bar{\beta}(x)$	BBAR	Mean advance angle in degrees for a given radius
$+\Delta\beta$	BPOS	Variation of the maximum advance angle from the mean for a given radius

NOTATION (Continued)

$-\Delta\beta$	BNEG	Variation of the minimum advance angle from the mean for a given radius
θ	Angle in Degrees	Position angle (angular coordinate) in degrees



VELOCITY DIAGRAM OF BETA ANGLES

ENGLISH/SI EQUIVALENTS

ENGLISH	SI
1 inch	25.400 millimeters [0.0254 m (meters)]
1 foot	0.3048 m (meters)
1 foot per second	0.3048 m/sec (meters per second)
1 knot	0.5144 m/sec (meters per second)
1 pound (force)	4.4480 N (Newtons)
1 degree (angle)	0.01745 rad (radians)
1 horsepower	0.7457 kW (kilowatts)
1 long ton	1.016 metric tons or 1016 kilograms
1 inch water (60°F)	248.8 pa (pascals)

ABSTRACT

This report describes a series of model experiments conducted as part of the overall project of the David Taylor Naval Ship R&D Center (DTNSRDC) to adapt controllable pitch propellers to the needs of high speed combatant ships. The first set of experiments was conducted on a model of the R/V ATHENA, with and without the port propeller operating. The second set of experiments repeated the first, except that the Bass Dynamometer Boat was mounted aft of the model. The third set was a series of idealized wake distribution experiments, in which the model was removed and the pitot rake was mounted upstream of the Bass Boat. The effect of an operating port propeller on the mean starboard wake distribution was small. The presence of the Bass Boat behind the ATHENA model, however, affects both the mean values and the harmonic content of the wake. Finally, one idealized mean wake distribution was shown to be weakly dependent on speed, and the harmonic content of wakes at two different speeds differed by less than three percent.

ADMINISTRATIVE INFORMATION

The experimental program was initiated and funded by the Naval Sea Systems Command (NAVSEA 05R) under Task Area S0379001. This work was performed at the David Taylor Naval Ship R&D Center (DTNSRDC) under work unit number 1524-641. The preliminary data analysis was performed by Chi Associates, Inc. (CAI) under contract to DTNSRDC.

INTRODUCTION

As part of its overall project to adapt controllable pitch propellers to the needs of high speed combatant ships, the David Taylor Naval Ship Research and Development Center (DTNSRDC) conducted a full-scale wake survey aboard the R/V ATHENA in September 1977 as reported by Day et al[1]. The specific goal of this project was to obtain propeller disk velocity component ratios in the wake of a full-scale ship. In addition, propeller blade loading experiments have been completed for the R/V ATHENA.

Subsequent to the full-scale wake trials, a series of wake surveys were conducted on a model of the R/V ATHENA. These experiments were designed to evaluate the model wake at one propeller location, both with and without the other propeller operating. In addition, wake survey experiments were conducted with and without the Bass Dynamometer Boat mounted aft of the model. The Bass Dynamometer Boat was used in the blade loading experiments to drive the propeller and dynamometry systems from behind the model. The wake information was necessary to account for the effect of the Bass Boat on the flow into the propeller in the analysis of the blade loading experiments. Several idealized wake distributions were measured, and will be used for blade loading calculations for a propeller operating in an idealized wake. An idealized wake is the breaking down of a wake field into a purely longitudinally dominated wake by a wake screen or a purely tangentially dominated wake by inclining the flow angle. The blade loading calculations for the R/V ATHENA will be compared with experimental force measurements on a model propeller to help determine the validity of the load calculation method and will be reported later.

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[1] References are listed on page 16.

EXPERIMENTAL PROCEDURE

The experiments described in this report measured the propeller disk velocity components under a variety of operating conditions. In the first set of experiments (Experiments 3, 9 and 10), wake measurements were obtained from the starboard propeller plane of the model with, and without the port propeller operating. In the second set (Experiments 11 and 12), measurements were taken with the model followed by the Bass Dynamometer Boat, with and without the port propeller operating. The third set of experiments (Experiments 13 through 16) consisted of idealized wake surveys. The ATHENA model was removed, and a pitot tube rake was mounted ahead of the Bass Dynamometer Boat. These experiments were run behind a screen which provided an idealized wake distribution.

DTNSRDC Model 5365, representing the R/V ATHENA (PG-94), was constructed to a linear ratio of 8.250, in accordance with model specifications of the Naval Sea Systems Command (NAVSEA 05R). Model and ship characteristics are presented in Table 1. The model was fitted with shafts and struts, a centerline skeg, and stabilizer fins. Model rudders were not included. DTNSRDC pitot tube rake number 7 was mounted in the model through the starboard shafting. Differential pressure gauges were used to measure the velocities in the plane of the propeller at four radial locations. A sketch of the pitot rake on the model is shown in Figure 1. The rake as fitted to Model 5365, including the five-hole spherical pitot tubes, is shown in Figure 2.

The DTNSRDC Bass Dynamometer Boat (Model 5271) was employed in all but the first three experiments. It was mounted in the same location in which it had previously been run to study unsteady propeller blade

forces behind a model, and was later mounted behind the pitot rake and wake screen.

The experimental program, as it pertains to this report, is described in Table 2. The experiments being discussed are 3 and 9 through 16. All the other experiments (1, 2, and 4 through 8) are discussed in another report by Hurwitz and Crook[2]. Experiment 3 was a conventional wake survey experiment which measured the Model 5365 starboard wake without the port propeller operating in the initial setup. Experiment 9 repeated this test to verify that the model conditions were essentially unchanged in the second setup from the original. For Experiment 10, with the port propeller operating, the model conditions from Experiments 3 and 9 were duplicated.

Experiments 11 and 12 were again conventional wake surveys, with the pitot tube rake mounted from inside the starboard shaft; but the Bass Dynamometer Boat was attached downstream of the ATHENA model. Experiment 11 was conducted without the port propeller, and Experiment 12 with the port propeller operating. A sketch of the experimental radii taken with the pitot tube arrangement behind the hull sections is shown in Figure 3. Figures 4 and 5 are profile and quartering photographs of the pitot tube rake and the ATHENA model. Figure 6 shows the experimental setup during Experiments 11 and 12.

Experiments 13 through 16 were conducted to create idealized wakes. Data from these wake surveys were required to perform calculations of unsteady blade loads for comparison with experimental results. Experiment 13 modeled an uniform flow with the rake inclined at 20 degrees (0.349 radian), as shown in Figure 7. Experiment 14 was performed to measure the flow behind a one-cycle wake screen with the bass dynamometer boat

and rake both at zero degree inclination. Figures 8 through 10 show the wake screen used, and Figures 11 and 12 show the experimental setups. Finally, Experiments 15 and 16 were uniform flow surveys at ten degrees (0.175 radian) inclination of the bass dynamometer boat and rake at model speeds corresponding to full-scale speeds of 17.2 and 8.6 knots (8.8 and 4.4 m/s), respectively. Also the single cycle wake screen was removed during Experiments 15 and 16.

The full-scale propeller disk was 6 feet (1.83 meters) in diameter. The radii at which measurements were made, expressed as ratios of the propeller radius (r/R), were 0.456, 0.633, 0.781, and 0.963. The plane in which the velocity measurements were taken was the starboard propeller plane located 146.2 feet (44.56 meters) aft of the forward perpendicular. The ATHENA displacement was 263 tons (267 metric tons), and the model trim was locked at a speed corresponding to a 20 knot (10.3 meter/second) ship speed, with the pitot rake in the zero degree position.

The wake measurement system consisted of a pitot tube rake and four differential pressure gages. The rake has five 5-hole spherical pitot tubes mounted in a common housing. Measurements were not made using the innermost pitot tube because of the flow interference between the pitot tube and the propeller hub. Figure 1 shows the arrangement of the rake and the pitot tubes. A description of the use and the calibration of 5-hole tubes is given by Hadler and Cheng.[3]

The carriage computer integrated the four pressure signals from each pitot tube, the model speed, and the angular position of the rake, over a 5-second period. Digital voltmeters and frequency counters monitored the computer values. The computer collected the pressure data for each of the

four pitot tubes. The rake was then rotated to a new angle, and the procedure was repeated until data were obtained throughout the entire rotation of the rake in the propeller disc.

Velocity component ratios were computed from the pressure data using established computer programs. The circumferential distributions of the longitudinal, tangential, and radial velocity component ratios were plotted for each radial location. Plots of the data were generated by a Control Data Corporation (CDC) Computer using a CALCOMP Plotter. Data were checked for random errors and agreement with previous experiments. Interpolation of the velocity component ratios in the radial and circumferential directions was made. This process yielded interpolated data every 2.5 degrees (0.044 radians) for four experimental radii, and for additional selected radii (interpolated radii). The mean longitudinal, tangential, and radial velocity component ratios; the volumetric mean wake; and the mean and extreme values of the advance angles were computed and are presented in this report. The advance angles were calculated using an advance coefficient, J_V, of 0.739. Explanation of this terminology and a diagram showing the relationship among the velocity vectors, the advance coefficient, and the advance angles are presented in the "Notation" section of this report.

Harmonic analyses of the circumferential distributions of the longitudinal and tangential velocity component ratios were computed for the experimental data. The harmonic content was determined by Fourier series analysis. The results of the harmonic analyses are presented as amplitudes and phase angles of a sine series.

ACCURACY ASSESSMENT

The instrumentation accuracy and the repeatability of wake survey experiments have been discussed in detail by Hadler and Cheng,[3] and Day[4]. The mean velocity component ratios and the harmonic amplitudes of these ratios all repeat within one percent of the model velocity. The accuracy of the entire velocity survey measurement system was also determined to be one percent of the model velocity, except in flow regions where steep velocity gradients occur, such as behind a shaft strut. In these high gradient regions, the accuracy was shown to be much less. These error bounds were derived for wake surveys calculated at model speeds of at least four knots, with the accuracy decreasing at lower speeds.

All data comparisons which follow will be referenced to the model velocity. Since the accuracy is on the order of one percent of the model velocity, highe order harmonics, whose amplitudes tend to be less than one percent of model velocity, cannot be considered to be as accurate as the mean values and lower order harmonics. The small higher order harmonics do not make a significant contribution to the reproduction of the velocity component ratios, though they do contribute to moments and forces calculated from the wake harmonics.

PRESENTATION AND DISCUSSION OF RESULTS

EXPERIMENTS 3, 9, AND 10 - EFFECT OF OPERATING PORT PROPELLER ON CONVENTIONAL WAKE SURVEYS

Experiments 3, 9, and 10 were conventional wake surveys of the starboard propeller plane of the R/V ATHENA (Model 5365). Experiment 3 was conducted without the port propeller operating, Experiment 9 was a check of

Experiment 3, and Experiment 10 was identical to Experiment 3, except that the port propeller was operating.

A listing of the input data for Experiment 3 (without the port propeller operating) is presented in Table A-1, of Appendix A. The circumferential distribution of the longitudinal, tangential, and radial velocity component ratios from Experiment 3 are shown in graphical form for each pitot tube radius in Figures A-1 through A-4. Included in these figures are the data from Experiment 9, which agree with the data for Experiment 3. The mean longitudinal (VXBAR), tangential (VTBAR), and radial (VRBAR) velocity component ratios, and the volumetric mean wake (1-WX) are presented in Table A-2. These quantities, except the radial mean, are presented graphically in Figure A-5.

The calculated mean values of the advance angle (BBAR), and the extreme variations (BPOS and BNEG) are shown in Figure A-6 and Table A-2. Tables A-3 through A-6 present the harmonic analyses of the circumferential distributions of the longitudinal and tangential velocity component ratios at the experimental and interpolated radii.

The results are presented in a similar form for Experiment 10 (with the port propeller operating). The circumferential distributions of the velocity component ratios are presented in Appendix B as Figures B-1 through B-4, the input data are listed in Table B-1, and mean values are presented in Figures B-5 and B-6, and Table B-2. The results of the harmonic analyses are presented in Tables B-3 through B-6.

When the results from Experiments 3 and 10 are compared, only small differences are seen. The mean values for the input radii of longitudinal,

tangential, and radial velocity listed in Tables A-2 and B-2 agree in most cases to within one percent of the freestream velocity. The circumferential mean values from Experiment 3 are not consistently higher or lower than those from Experiment 10.

The results of the harmonic analyses compare just as favorably. For example, at the input radii, the amplitudes of all harmonics of the longitudinal, tangential, and radial velocity component ratios differ by less than one percent of freestream. The phase angles, however, are different at several radii. The good agreement of the data, all within experimental accuracy, for Experiments 3 and 10, indicates only a small effect on the starboard wake is realized when the port propeller is operating.

EXPERIMENTS 11 AND 12 - EFFECT OF OPERATING PORT PROPELLER IN FRONT OF BASS DYNAMOMETER BOAT MOUNTED DOWNSTREAM

Experiments 11 and 12 were conventional wake surveys on the starboard propeller plane of the R/V ATHENA (Model 5365), with the Bass Dynamometer Boat (Model 5271) mounted downstream. This setup physically modeled the unsteady blade force experiments mentioned previously. Experiment 11 was conducted without the port propeller operating, and Experiment 12 was identical to Experiment 11, except that the port propeller was operating.

The circumferential distribution of the longitudinal, tangential, and radial velocity component ratios for Experiment 11 are shown graphically for each pitot tube radius in Appendix C as Figures C-1 through C-4. A listing of the input data is presented in Table C-1. The mean longitudinal, tangential, and radial velocity component ratios and the volumetric mean wake are presented in Figure C-5 and Table C-2.

The calculated mean and extreme values of the advance angles are also shown in Table C-2 and in Figure C-6. Tables C-3 through C-6 present the results of harmonic analyses of the circumferential distributions of the longitudinal and tangential velocity component ratios at the experimental and interpolated radii.

The results are presented in a similar form for Experiment 12. The circumferential distributions of the velocity component ratios are presented in Figures D-1 through D-4, the input data is listed in Table D-1, and the mean values are presented in Figures D-5 and D-6, and in Table D-2. The harmonic analyses are presented in Tables D-3 through D-6.

When the results from Experiments 11 and 12 are compared, only small differences are seen. The mean values of the longitudinal, tangential, and radial velocity component ratios for the input radii all agree to within one percent of freestream. At each radius, the longitudinal mean velocity component ratio is slightly higher with the port propeller operating (Experiment 12). However, the values are so nearly the same that no conclusions can be drawn regarding the trend.

The results of the harmonic analyses also compare favorably. For example, at the input radii, the amplitudes of the first harmonic of the longitudinal velocity component ratios differ less than one percent of freestream. The phase angles, however, are different for several of the radii. The harmonics of the tangential velocity component ratios also show good agreement, with the differences being very small compared to free-stream with good phase angle agreement. These results further verify the earlier conclusions that with the port propeller operating only a small effect on the starboard wake distribution is realized.

EXPERIMENTS 9 AND 11 - EFFECT OF BASS DYNAMOMETER BOAT MOUNTED DOWNSTREAM

The results already presented from Experiments 9 and 11 can be compared to determine the effect of the Bass Dynamometer Boat on the ATHENA model wake. The differences are very significant. The mean values of the longitudinal velocity component ratios in Tables A-2 and C-2 showed differences of 10 to 20 percent of the model velocity. The longitudinal velocity component ratios were always smaller with the Bass Dynamometer Boat behind the ATHENA model, as expected. The tangential and radial mean ratios also changed, though no consistent trend was evident.

The harmonics of the longitudinal velocity component ratios showed some differences. For example, the amplitude of the first harmonic is slightly less when the Bass Boat is present; however, the fifth harmonic shows the opposite trend, that is, slightly higher when the Bass Boat is present. The tangential harmonics differ only slightly. For example, the amplitudes of the first harmonic taken with the Bass Boat differed by about 2 percent of freestream when compared to the amplitudes of the first harmonic without the Bass Boat.

EXPERIMENT 13 - IDEALIZED WAKE SURVEY AT LARGE INFLOW ANGLE

Experiment 13 was an idealized wake survey conducted with the Bass Dynamometer Boat downstream of only the pitot tube rake, that is, no ATHENA model was present for this experiment or single cycle wake screen. The rake inclination to the direction of travel was 20 degrees (0.349 radians).

The circumferential distribution of the longitudinal, tangential, and radial component ratios for Experiment 13 are shown graphically for each pitot tube radius in Figures E-1 through E-4. A listing of the input data

is presented in Table E-1. The mean longitudinal, tangential, and radial velocity component ratios and the volumetric mean wake are presented in Table E-2 and Figure E-5.

The calculated mean and extreme values of the advance angles are shown in Figure E-6 and Table E-2. Tables E-2 through E-6 present the results of harmonic analyses of the circumferential distributions of the longitudinal and tangential velocity component ratios.

The mean values presented in Table E-2 are not uniform for all radii, though all differences are less than three percent of model velocity. The circumferential mean values of velocity components for this experiment indicate that the Bass Dynamometer Boat not only retards the flow, but also has a small effect on the radial distribution of the flow.

EXPERIMENT 14 - IDEALIZED WAKE SURVEY WITHOUT ANY INFLOW ANGLE BEHIND A WAKE SCREEN

Experiment 14 was an idealized wake survey conducted with the Bass Dynamometer Boat mounted at zero degree inclination downstream of a one-cycle wake screen. The results are presented in a form similar to Experiment 13. The circumferential velocity component distributions are presented in Figures F-1 through F-4, the input data are listed in Table F-1, and the mean values are presented in Figures F-5 and F-6 and Table F-2. The results of harmonic analyses are presented in Tables F-3 through F-6.

The circumferential distributions shown in Figures F-1 through F-4 indicate that the wake screen did indeed produce a one-cycle wake with a peak-to-peak variation to longitudinal velocity component ratio of about 0.3. Table F-2 indicates that the mean longitudinal velocity component

ratio is about 0.63. The longitudinal harmonics presented in Table F-3 indicate that even though the wake has only one cycle the higher harmonics are still significant.

EXPERIMENTS 15 AND 16 - EFFECT OF SPEED ON IDEALIZED WAKE SURVEY

Experiments 15 and 16 were idealized wake surveys conducted with only the Bass Dynamometer Boat downstream of the pitot tube rake. There was no single cycle wake screen during these experiments. The rake inclination to the direction of travel was ten degrees for both experiments. Experiment 16 was identical to Experiment 15, except that the towing speed of Experiment 16 was one-half that of Experiment 15.

The circumferential distribution of the longitudinal, tangential, and radial velocity component ratios for Experiment 15 are shown in Figures G-1 through G-4. A listing of the input data is presented in Table G-1. The mean longitudinal, tangential, and radial velocity component ratios and the volumetric mean wake are presented in Table G-2 and Figure G-5.

The calculated mean and extreme values of the advance angles are shown in Figure G-6 and Table G-2. Tables G-3 through G-6 present the results of harmonic analyses of the circumferential distributions of the longitudinal and tangential velocity component ratios at the experimental and interpolated radii.

The results are presented in similar form for Experiment 16. The circumferential velocity component distributions are presented in Figures H-1 through H-4, the input data are listed in Table H-1, and the mean values are presented in Figures H-5 and H-6 and in Table H-2. The results of harmonic analyses are presented in Tables H-3 through H-6.

When the results from Experiments 15 and 16 are compared, only small differences are noted. The differences between mean values presented in Tables G-2 and H-2 are not significant with a maximum difference of about one percent of model velocity in the longitudinal mean, and a maximum difference in the tangential and radial means of less than one percent. The harmonics do not compare as favorably as the mean values, although the amplitudes of the first harmonic of the tangential velocity component ratios at the input radii differ by less than three percent of model velocity. The amplitudes of the first harmonic for the longitudinal ratios are in better agreement with the maximum difference being less than one percent of model velocity. These small differences indicate this idealized wake is only weakly dependent on speed.

CONCLUSIONS

(1) The effect due to the port propeller operating on the starboard mean wake distribution is small. This effect was illustrated twice and established no noticeable trends in the mean velocity component ratios.

(2) The Bass Dynamometer Boat mounted aft of the R/V ATHENA very significantly affects the mean longitudinal velocity component ratios. These mean longitudinal velocity component ratios with and without the Bass Dynamometer Boat differ by 10 to 20 percent. The results of the harmonic analyses show smaller trends. The radial distribution of the flow is also slightly influenced.

(3) The Bass Dynamometer Boat affects each radius differently due to the bass dynamometer blunt bow causing greater flow obstruction when at a 20 degree inclination.

(4) When a single cycle wake screen is mounted upstream of the Bass Dynamometer Boat, both at zero inclined angle, the wake screen affects the peak to peak fluctuations in the longitudinal velocity component ratios. These peak to peak fluctuation ranges are half the total mean longitudinal velocity component ratio values. The single cycle wake screen affects the higher harmonics significantly.

(5) The idealized flow wake surveys show a weak dependence upon velocity when the Bass Dynamometer Boat and rake are mounted at a ten degree angle of inclination to the free surface without any single cycle wake screen present.

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1. Day, W. G., Jr., A. M. Reed, R. B. Hurwitz, "Full-Scale Propeller Disk Wake Survey and Boundary Layer Velocity Profile Measurements on the 154-Foot Ship R/V ATHENA," DTNSRDC Ship Performance Department Report DTNSRDC/SPD-0833-01 (Sep 1980).

2. Hurwitz, R. B. and L. B. Crook, "Analysis of Wake Survey Experimental Data for Model 5365 Representing the R/V ATHENA in the DTNSRDC Towing Tank," DTNSRDC Ship Performance Department Report DTNSRDC/SPD-0833-04 (Oct 1980).

3. Hadler, J. B. and H. M. Cheng, "Analysis of Experimental Wake Data in Way of Propeller Plane of Single- and Twin- Screw Ship Models," Trans. Soc. Naval Arch. and Mar. Eng., Vol. 73, pp. 287-414 (1965).

4. Day, W. G., Jr., "Effect of Speed on the Wake in Way of the Propeller Plane for the DD 963 Class Destroyer Represented by Model 5265-1B," NSRDC Ship Performance Department Report SPD-311-37 (Jun 1975).

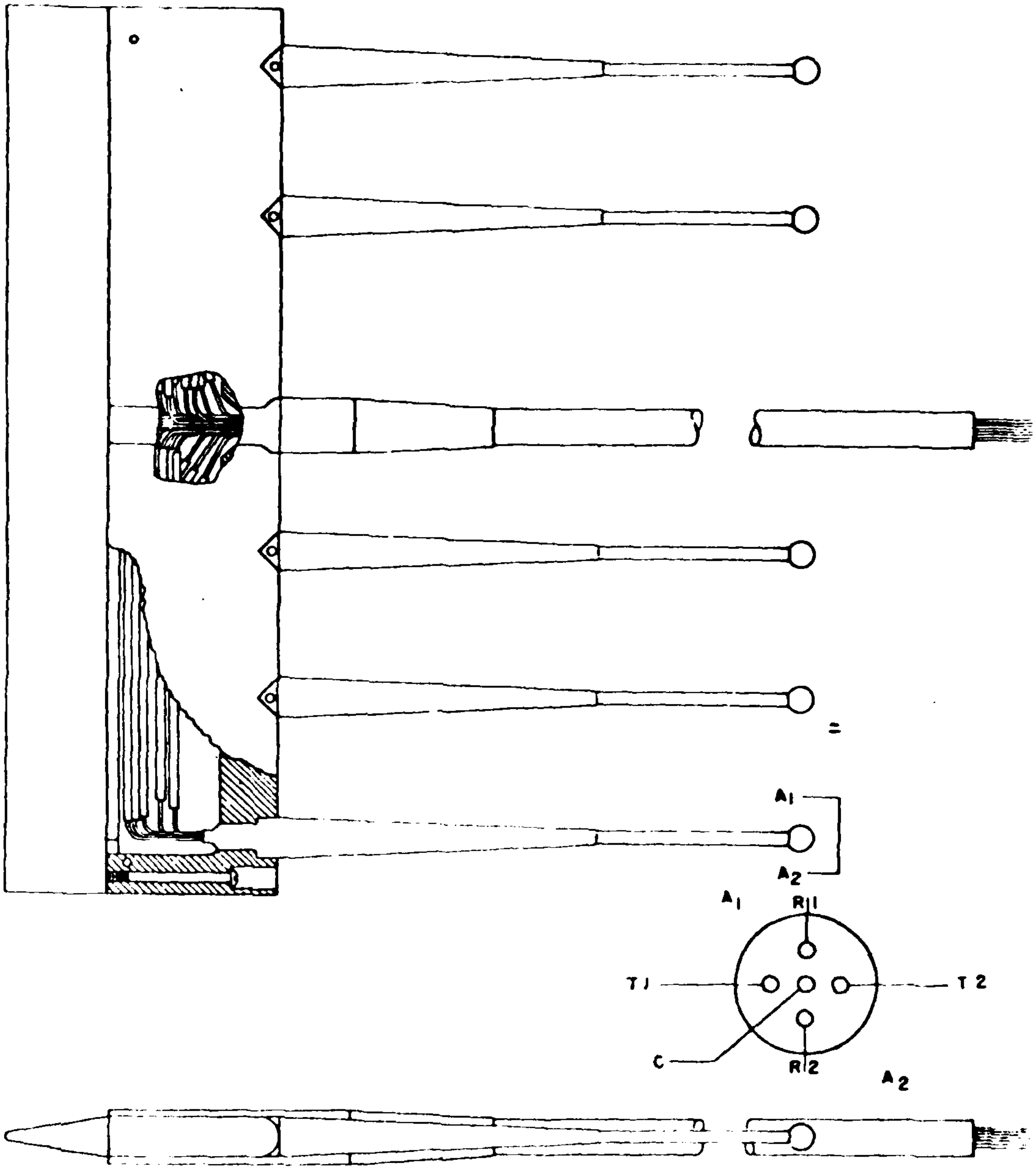


Figure 1 - Rake Arrangement Sketch Showing Five Spherical Head Pitot Tubes with Five Holes Each

PSD 0604-5-78-2

PSD 0605-5-78-5

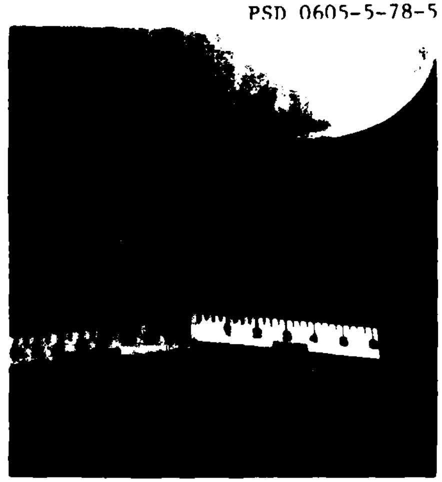


Figure 2 - Rake Arrangement Photographs Showing Installation in Starboard Shaft of Model 5365 During Experiments 3 and 9 Without Port Propeller

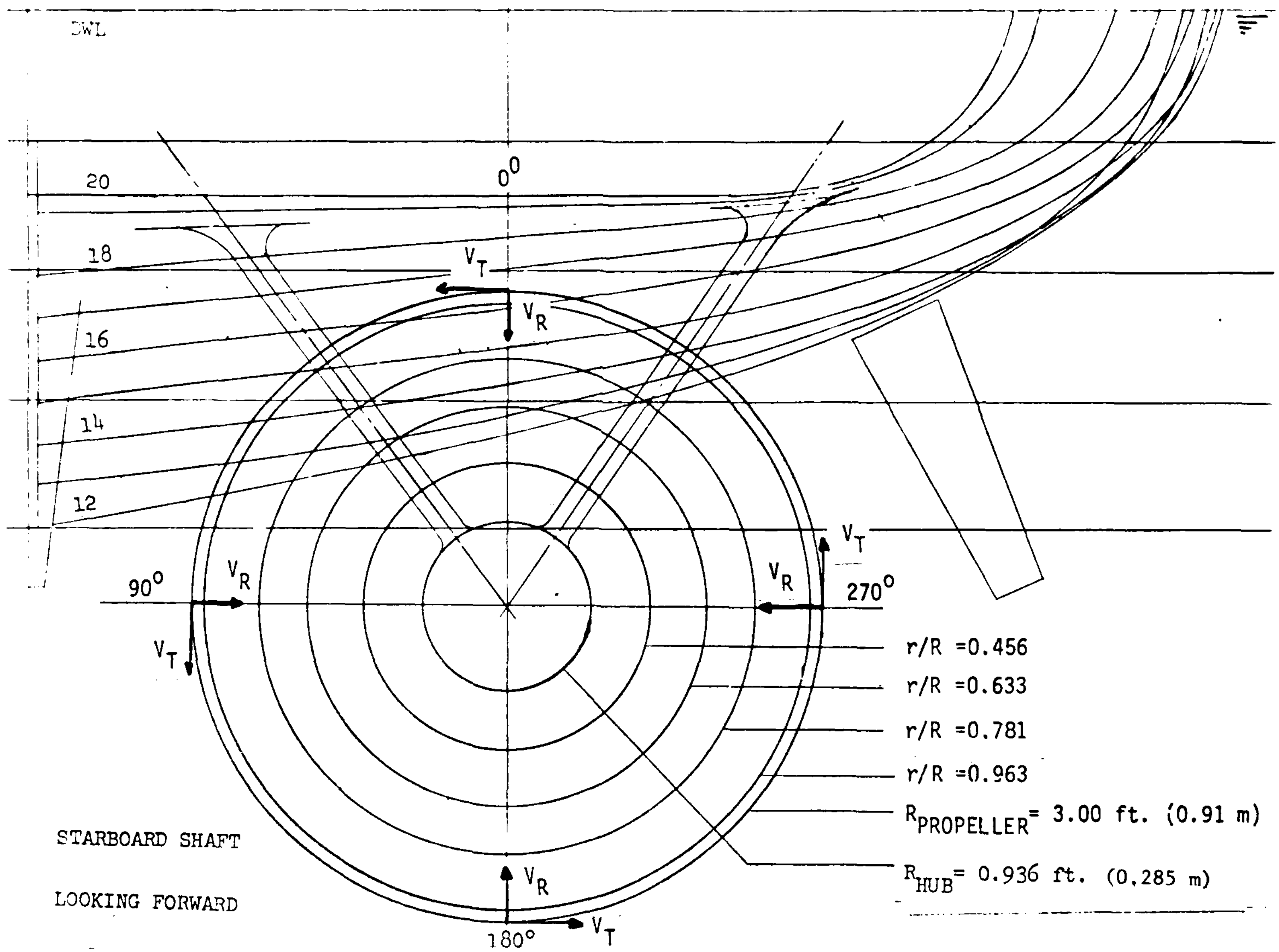


Figure 3 - Sketch Illustrating Location of Wake Survey Experimental Radii on Model 5365 Afterbody Sections Representing the R/V ATHENA

PSD 0604-5-78-9

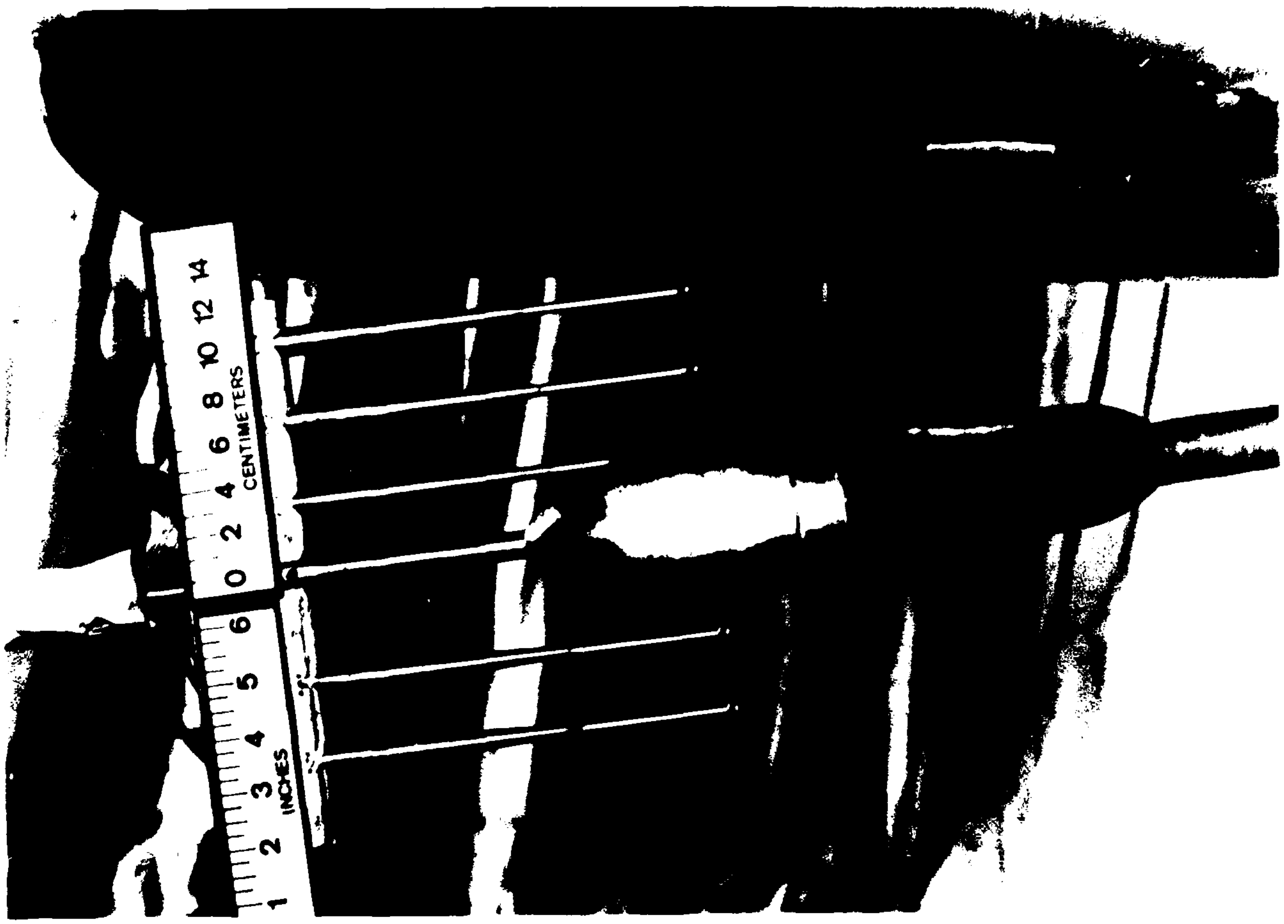


Figure 4 - Rake Arrangement Photograph Showing Closeup Profile View of Installation in Starboard Shaft of Model 5365 Without Port Propeller

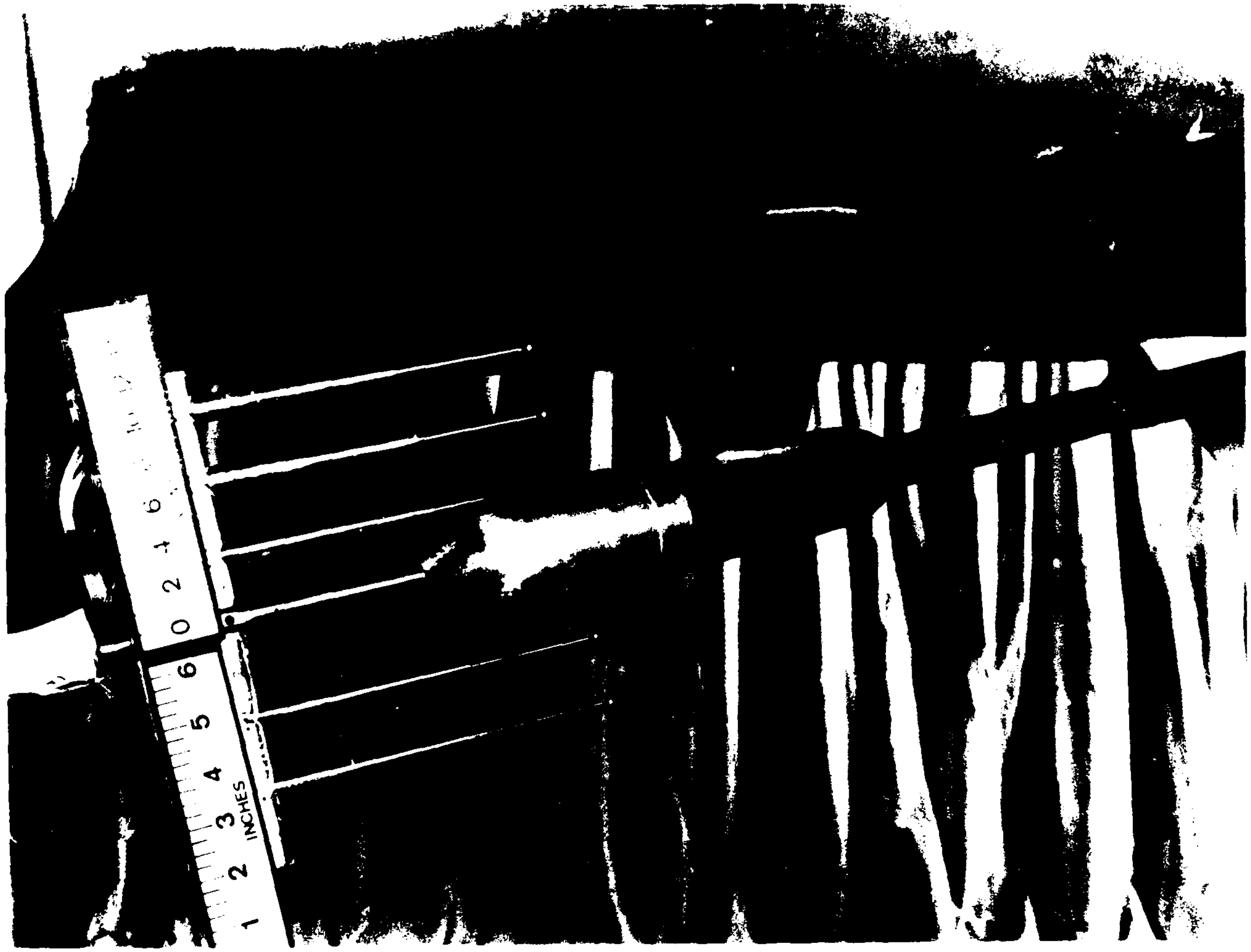
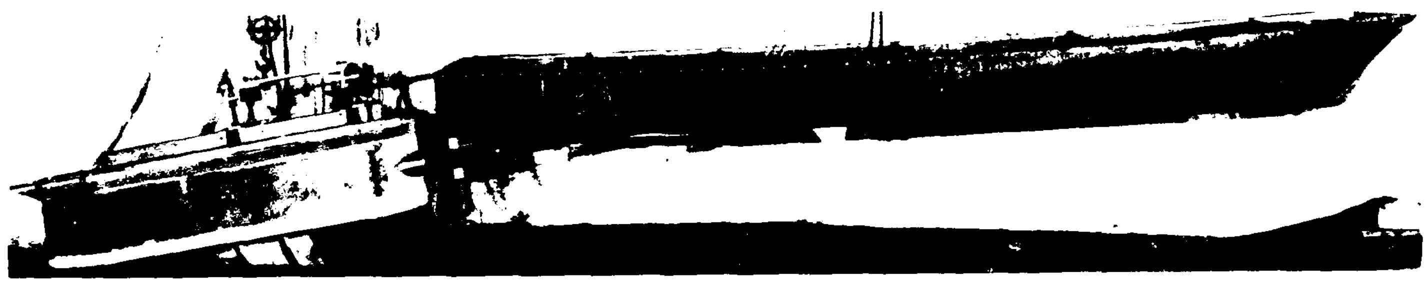


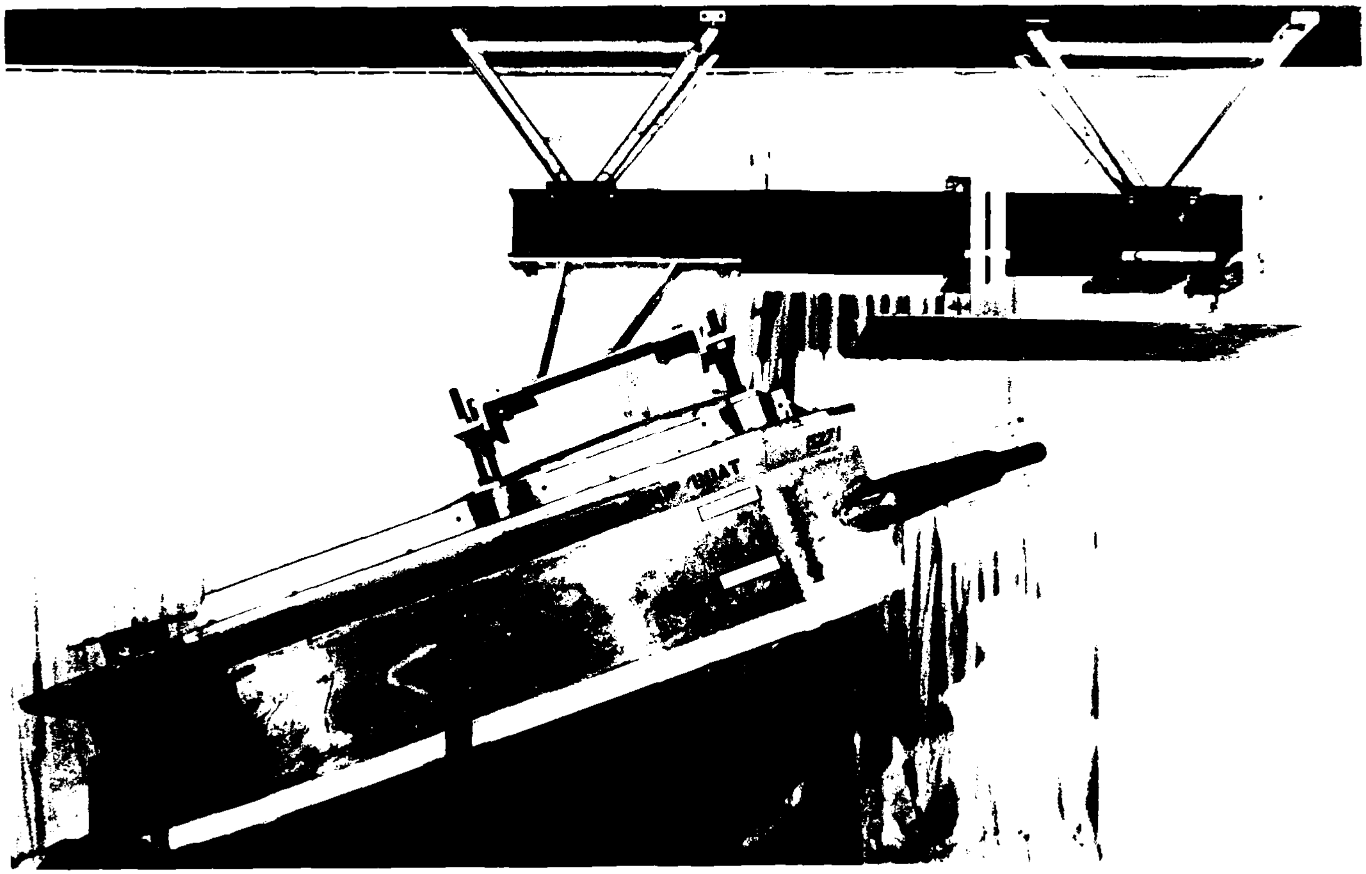
Figure [illegible] - Rake Arrangement Photograph Showing Closeup Quartering View of Installation in the Starboard Shaft of Model 5365 Without Port Propeller

PSD 0603-5-78-3



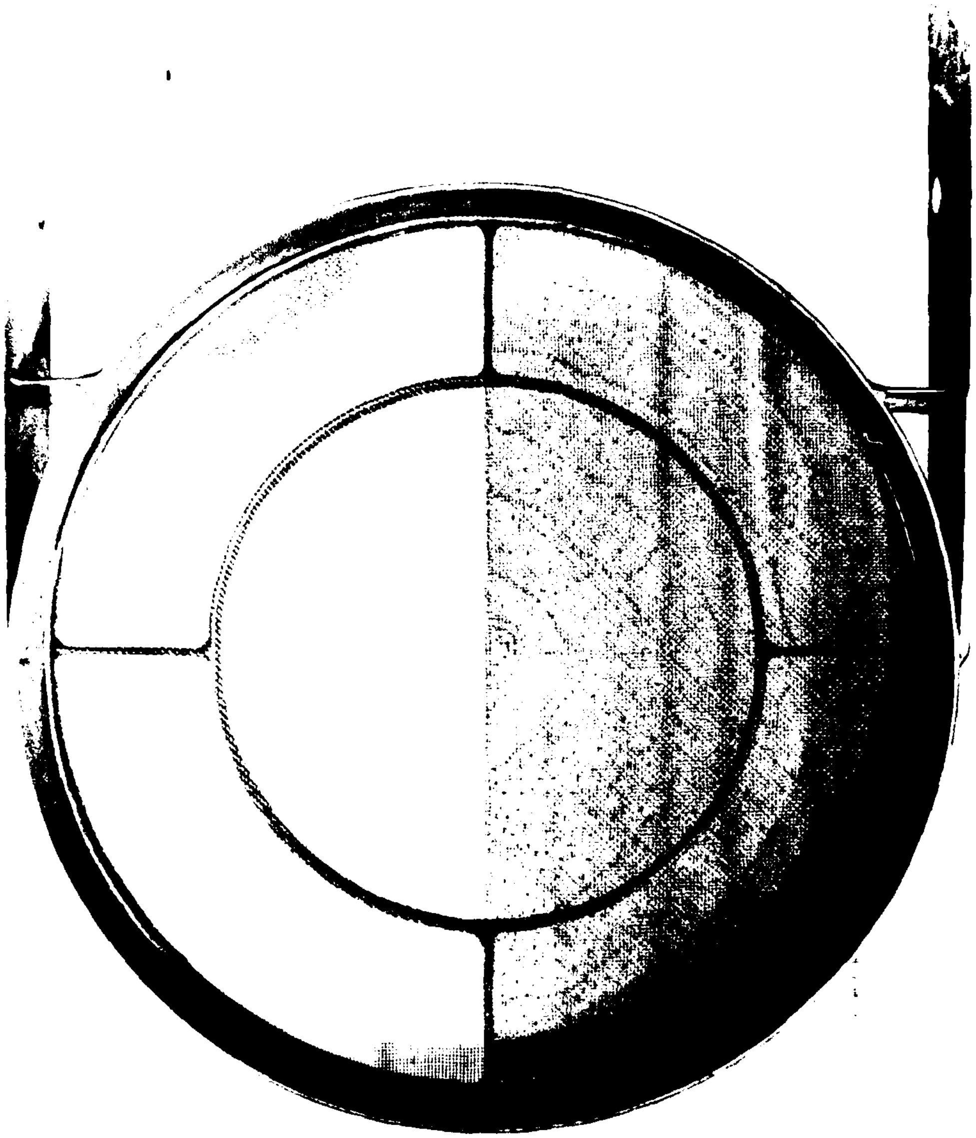
PSD 0604-5-78-1

Figure 6 - Rake Arrangement Photograph Showing Installation in Bass Dynamometer Boat, Model 5271, Mounted Behind Starboard Shaft of Model 5365 With and Without Port Propeller as During Experiments 11 and 12



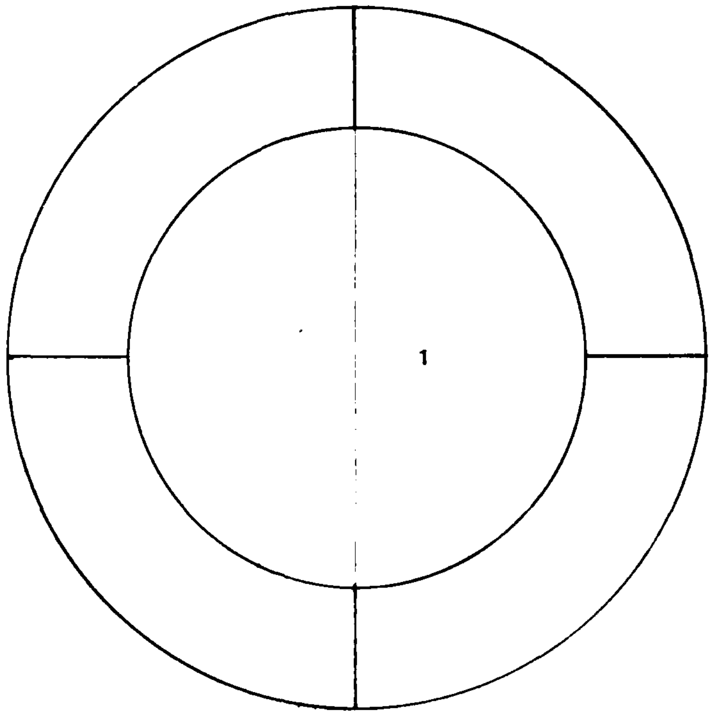
PSD 0606-5-78-3

Figure 7 - Rake Arrangement Photograph Showing Bass Dynamometer Boat Mounted for 20 Degree (0.349 radian) Inclined Idealized Flow Wake Experiment 13



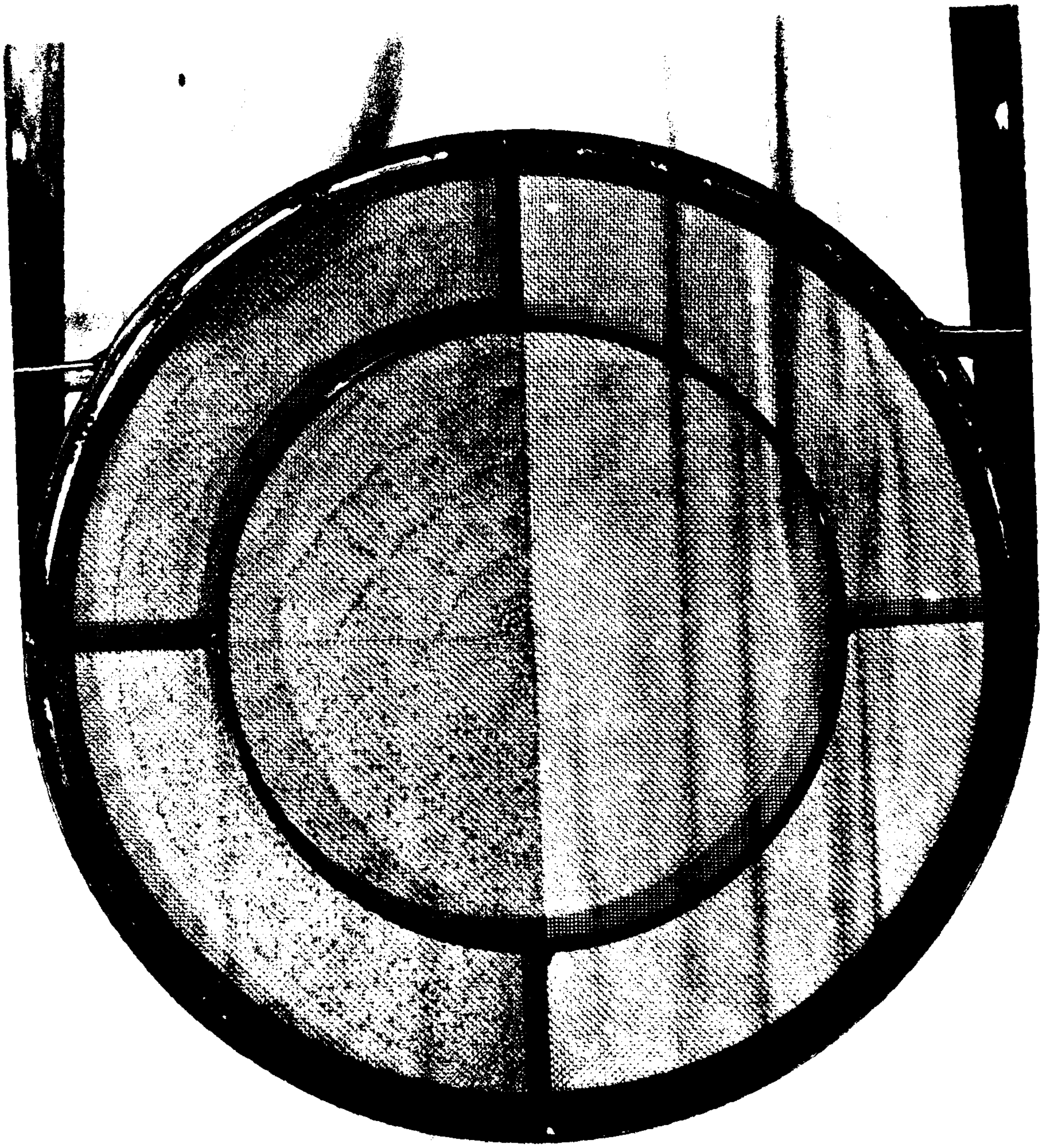
PSD 0607-5-78-1

Figure 8 - Wake Screen Photograph Showing Downstream View at Spherical Head Pitot Tubes Used for Idealized Flow Experiment 14



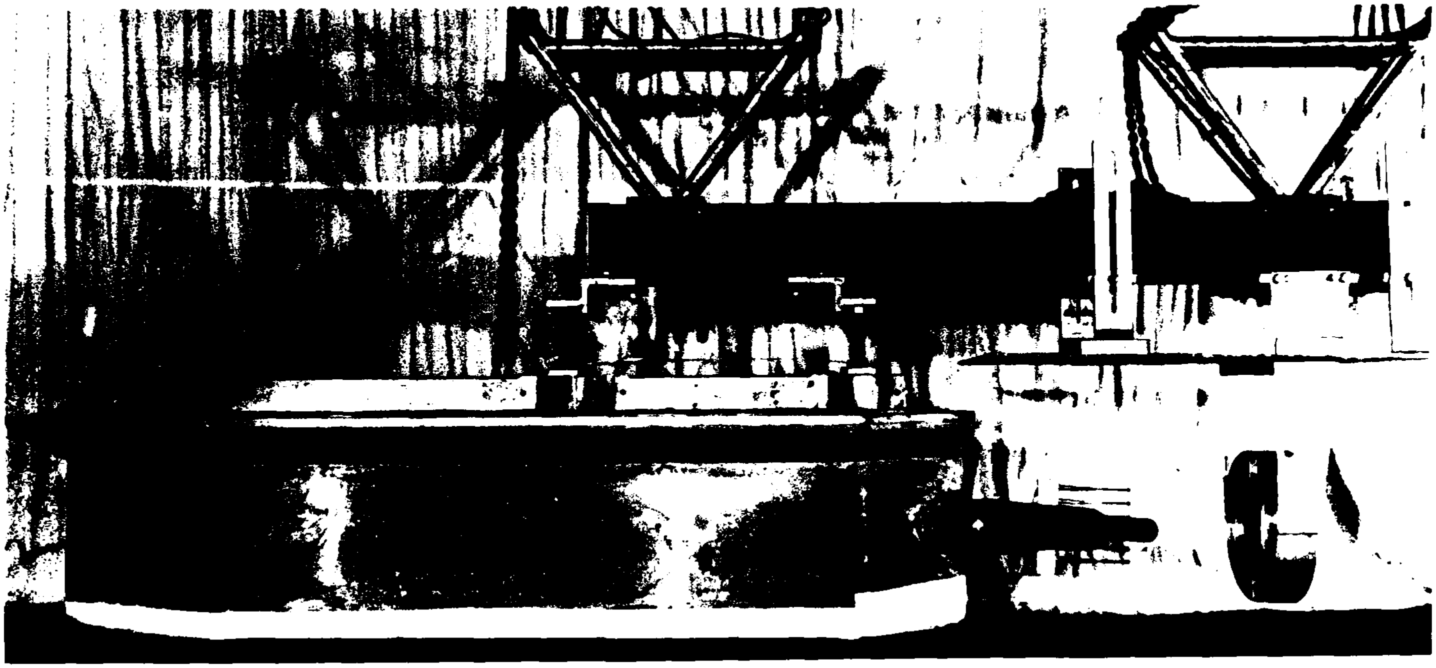
REGION	SCREEN SIZE	
	WIRES PER INCH	DIAMETER (inches)
SUPPORT (ALL)	16	0.009
1	20	0.011

Figure 9 - Schematic of Wake Screen Wire Sections and Sizes Used for Idealized Flow Experiment 14



PSD 0604-5-78-11

Figure 10 - Wake Screen Phototgraph Showing Upstream View Into the Flow for Idealized Flow Experiment 14



PSD 0606-5-78-7

Figure 11 - Bass Dynamometer Boat Mounted Behind the Wake Screen Photograph Showing Arrangement of Pitot Tubes for Idealized Flow Experiment 14

PSD 0606-5-78-7

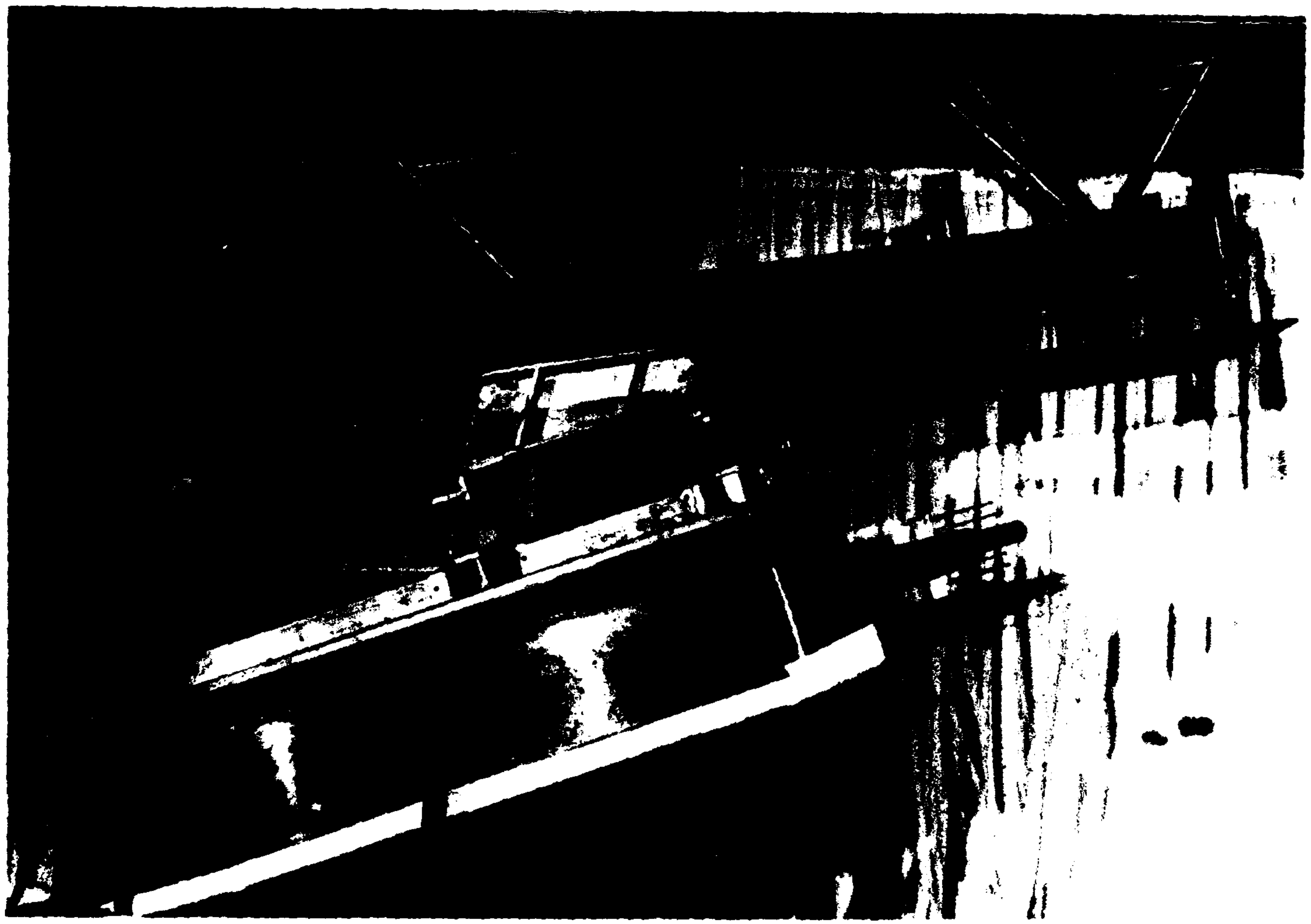


Figure 12 - Bass Dynamometer Boat Mounted for 10 Degree (0.174 radian) Inclined Idealized Flow Wake Photograph Showing Spacer Block Used for Experiments 15 and 16

TABLE I

Ship and Model Characteristics

R/V ATHENA Represented by Model 5365

	Ship	Model
Length Between Perpendiculars	154.0 ft (46.9m)	18.6 ft (5.7m)
Length Overall	164.5 ft (50.1m)	19.9 ft (6.1m)
Maximum Beam	24.0 ft (7.3 m)	2.9 ft (0.9m)
Displacement	263 tons (267.3 tonnes)	1020 lbs (462.6 kg)
Wetted Surface	3413 ft^2 (317.1 m^2)	50.15 ft^2 (4.659 m^2)
Draft	5.63 ft (1.72 m)	0.682 ft (0.208 m)
Trim by Stern	0.59 ft (0.18 m)	0.071 ft (0.022 m)
Propeller Diameter	6.0 ft (1.8 m)	8.73 in (22.2 cm)
Linear Scale Ratio	8.25	1.0

Propulsion: Twin screw, controllable pitch, 4 blades each

Appendages: Twin stabilizers, main shafts and V-struts, twin rudders, centerline skeg

APPENDIX A

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENTS 3 AND 9

Table 2

EXPERIMENTAL PROGRAM

Experiment Number	Equivalent Ship Speed in Knots (m/s)	Shaft Inclination	Athena Model	Dynamometer Boat	Wake Screen	Port Propeller Operating
3,9	20.0 (10.3)	*	yes	no	no	no
10	20.0 (10.3)	*	yes	no	no	yes
11	20.0 (10.3)	*	yes	yes	no	no
12	20.0 (10.3)	*	yes	yes	no	yes
13	11.5 (5.9)	20^{o}	no	yes	no	no
14	12.9 (6.6)	0^{o}	no	yes	yes	no
15	17.2 (8.8)	10^{o}	no	yes	no	no
16	8.6 (4.4)	10^{o}	no	yes	no	no

*Model trim set at equivalent ship speed twenty knots (10.3 meters/second)

APPENDIX A

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENTS 3 AND 9

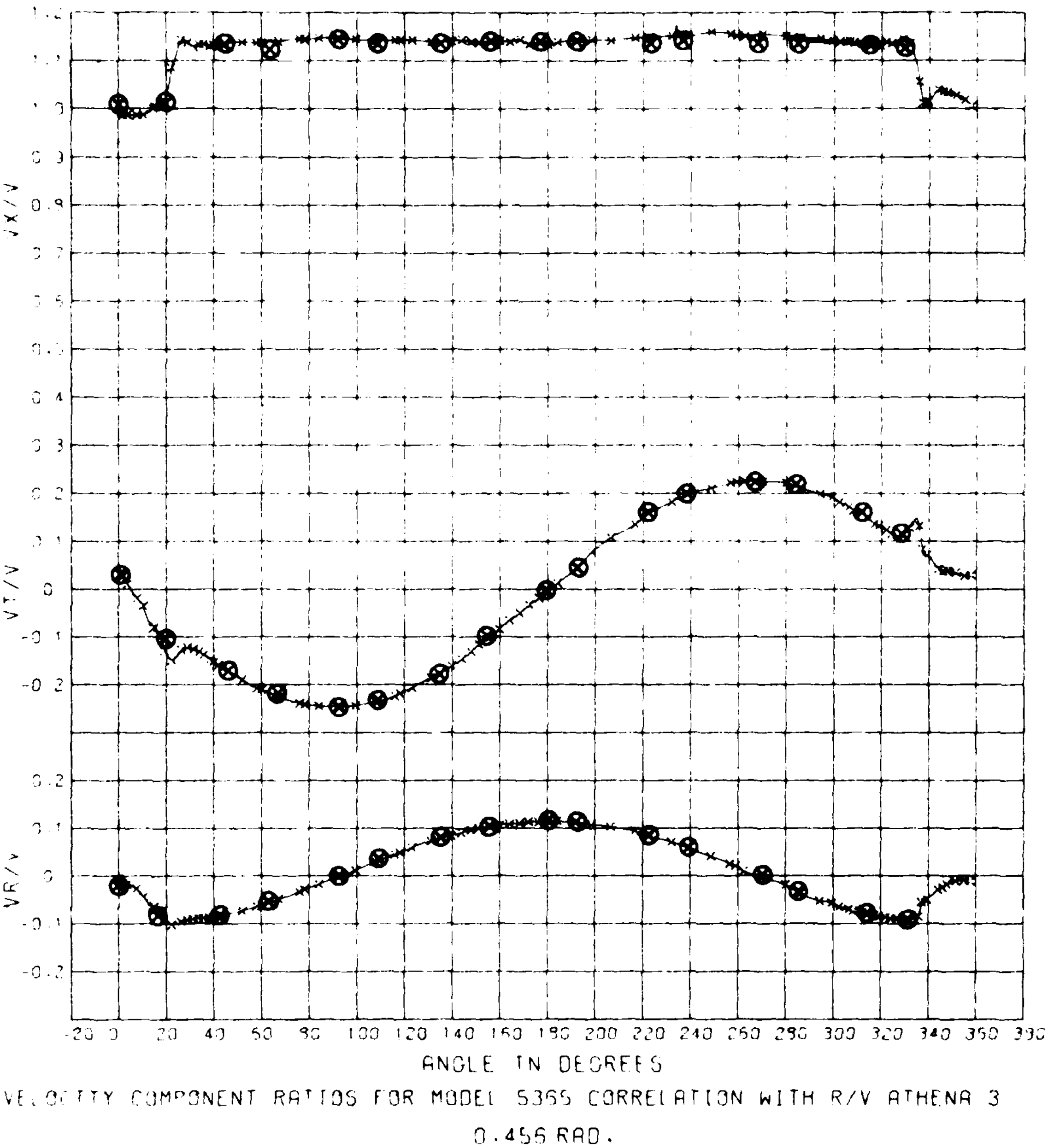
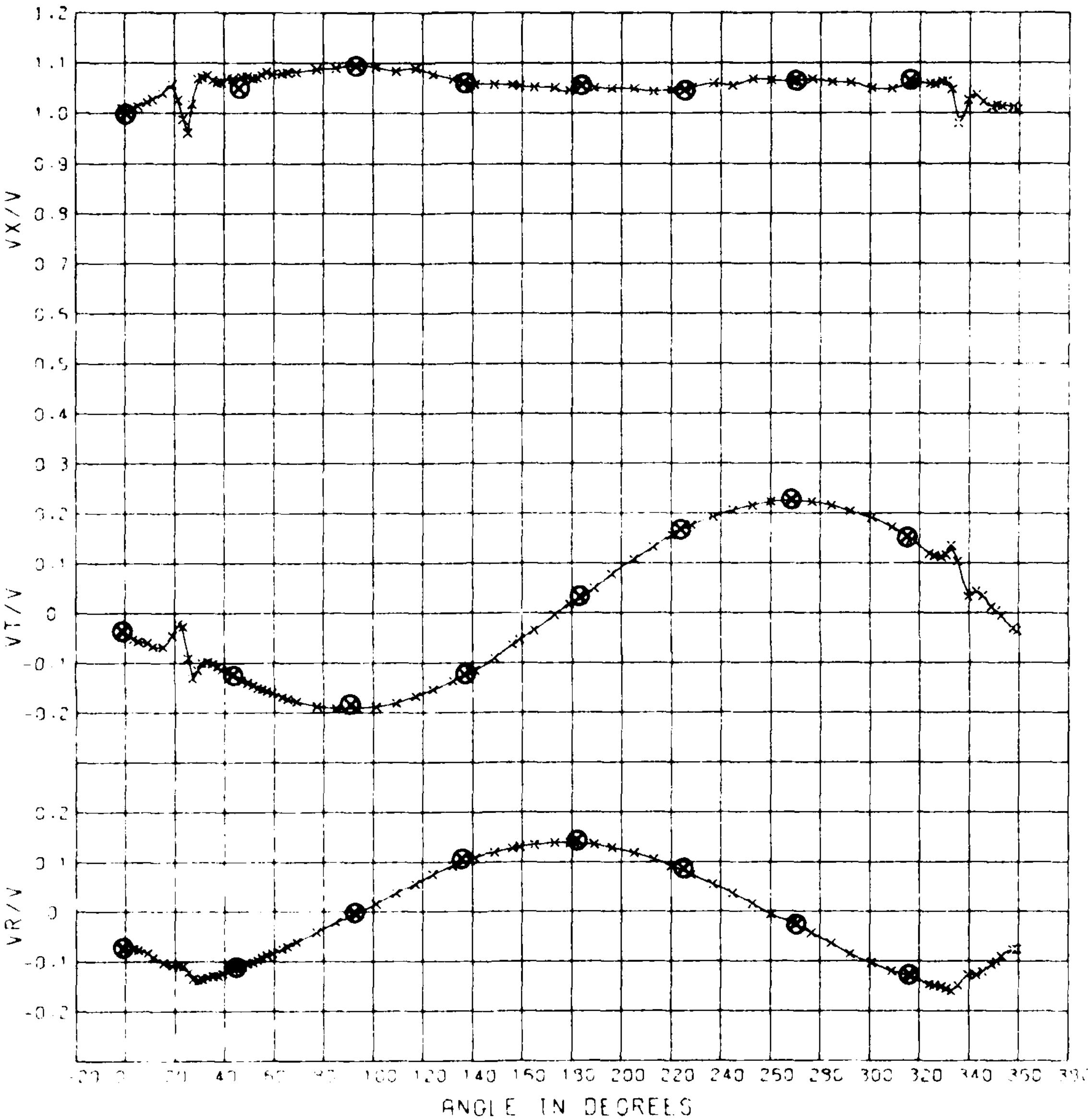


Figure A-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3

0.633 RAD.

Figure A-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9

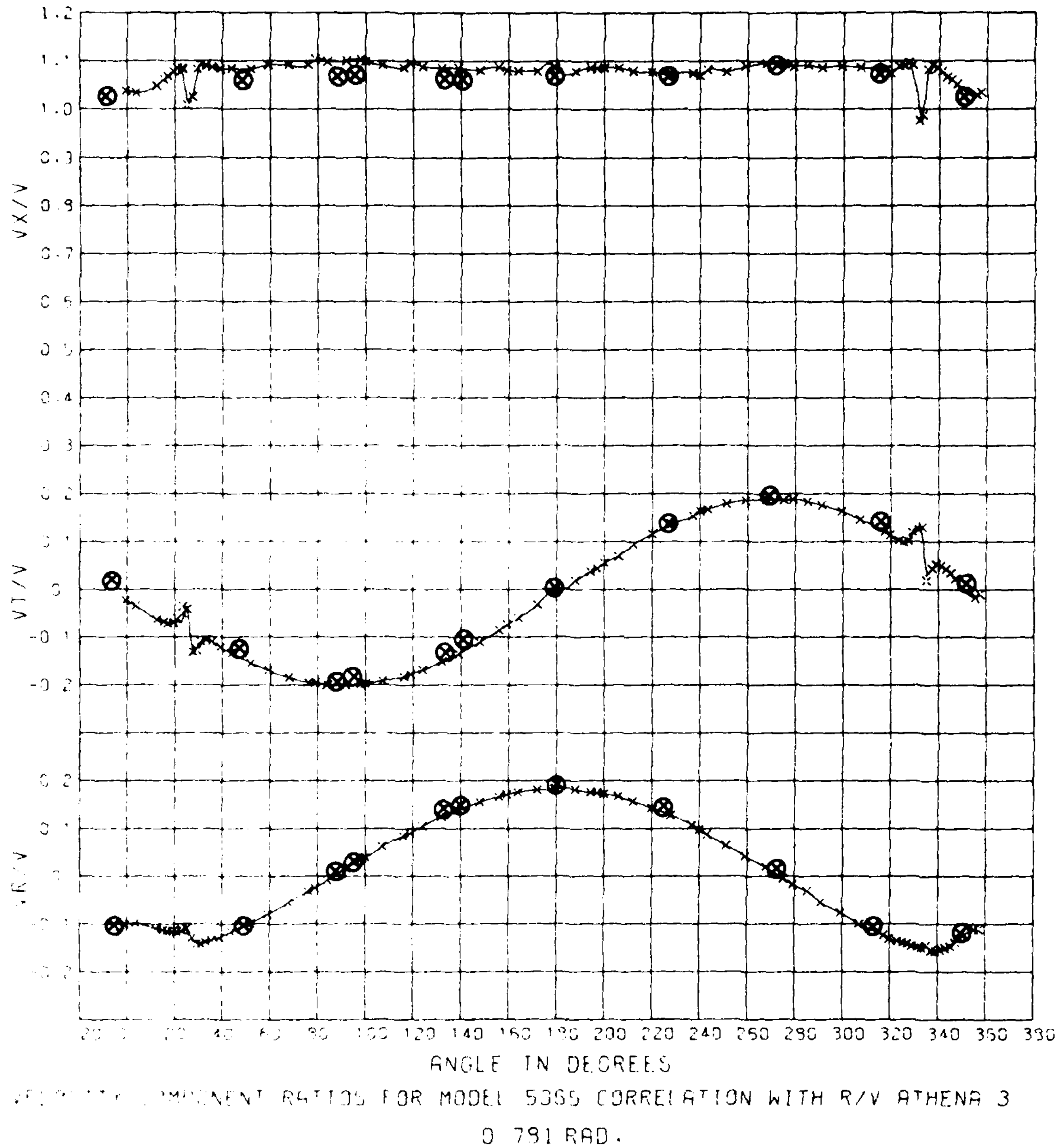
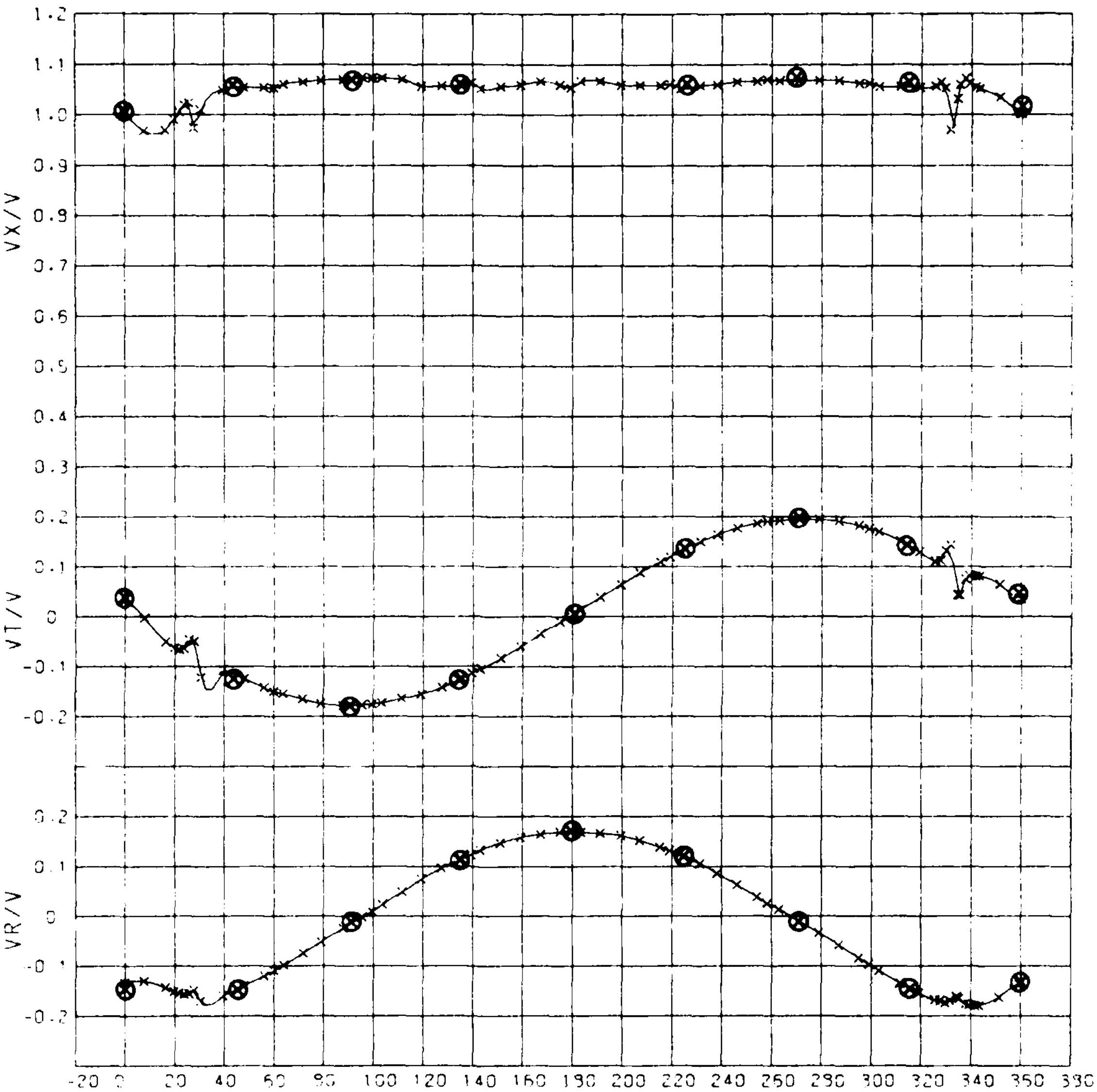


Figure A-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3

0.963 RAD.

Figure A-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiments 3 and 9

x : Experiment 3
⊗ : Experiment 9

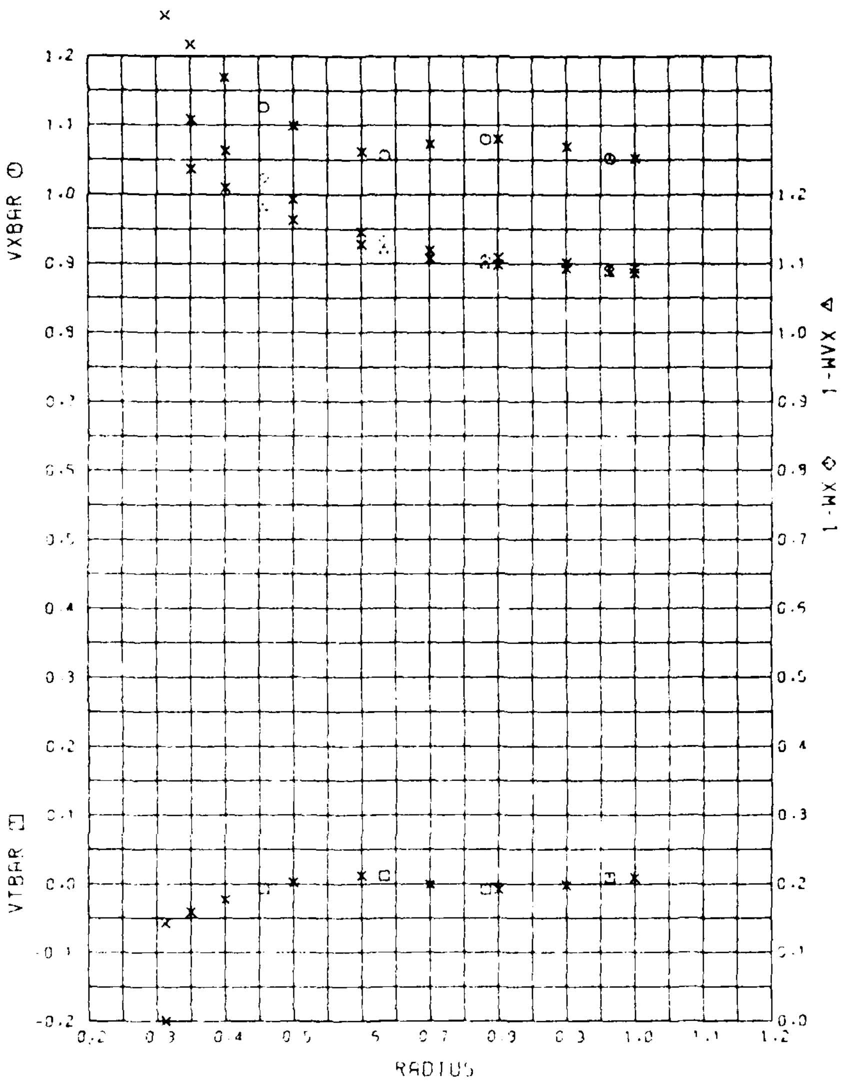


Figure A-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 3

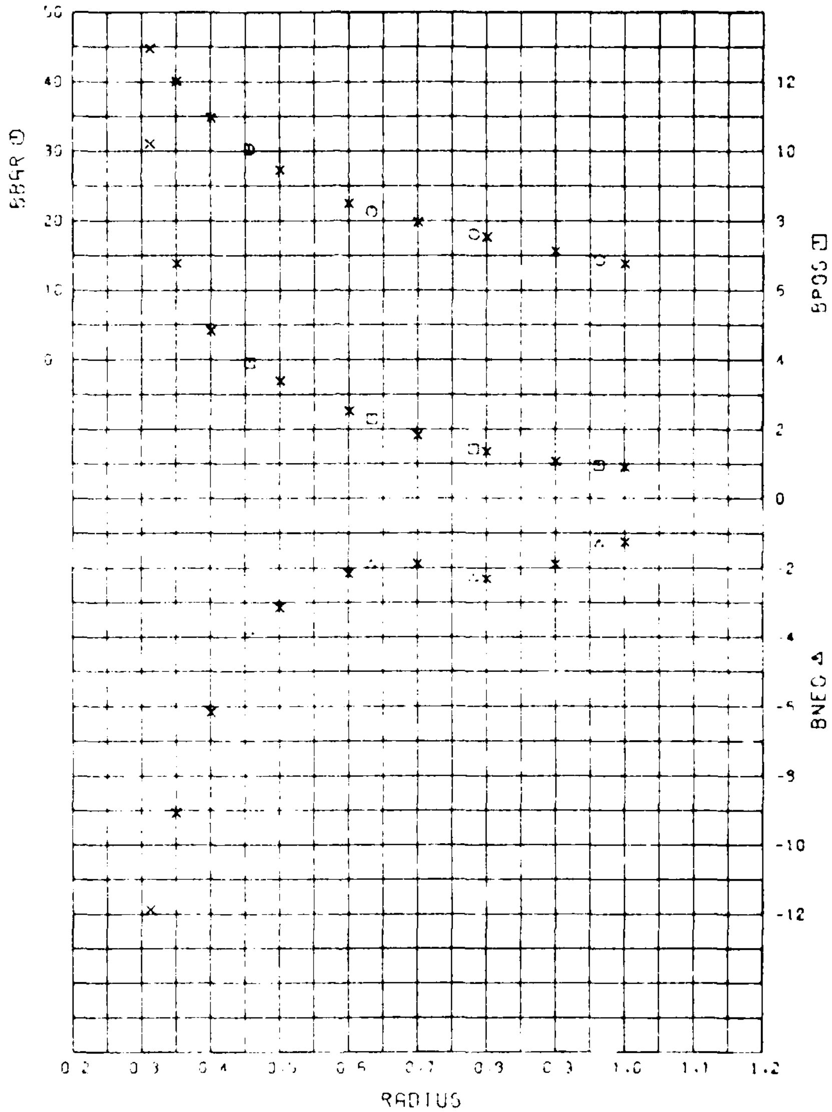


Figure A-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 3

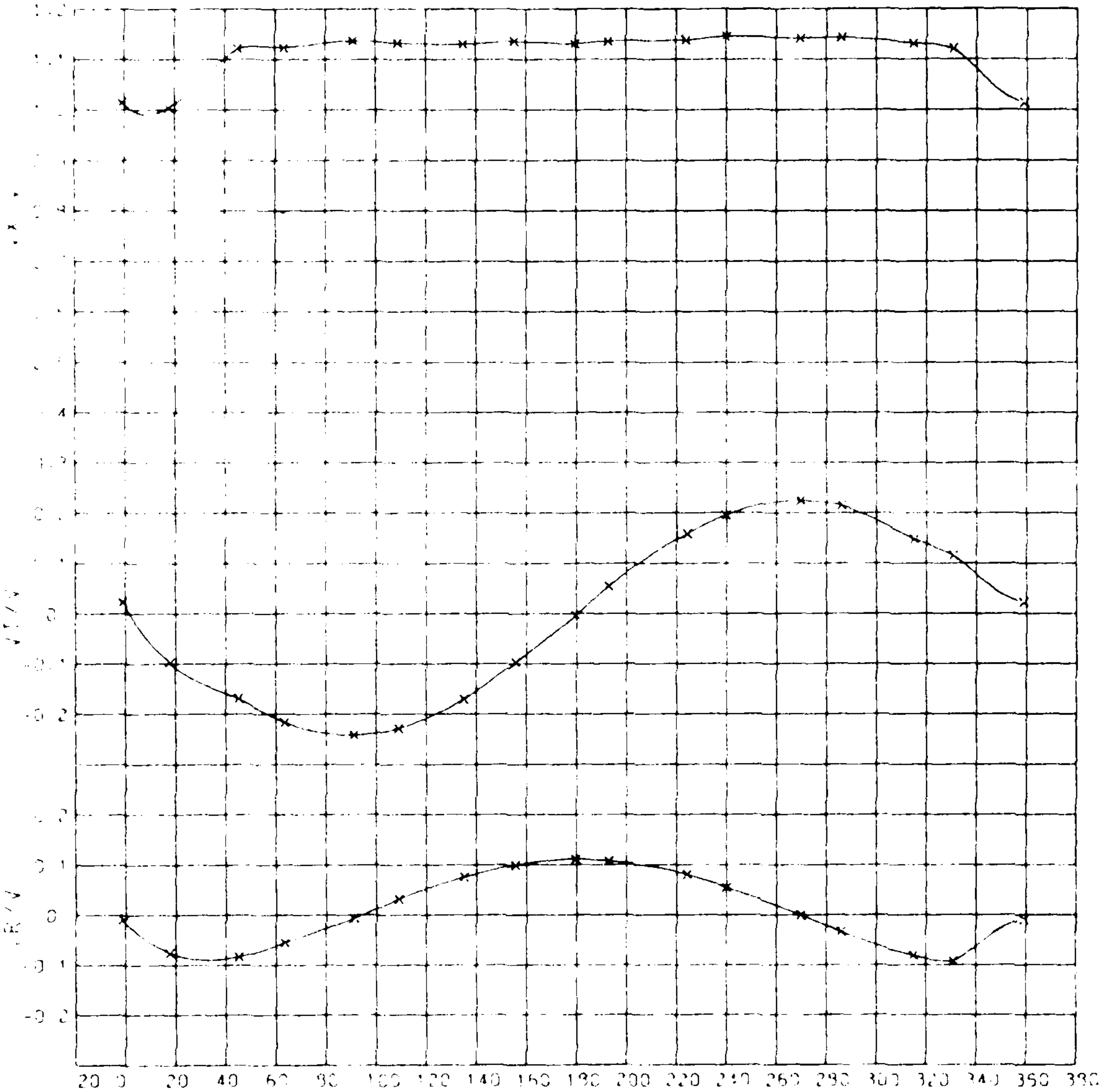


Figure A-7 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 9

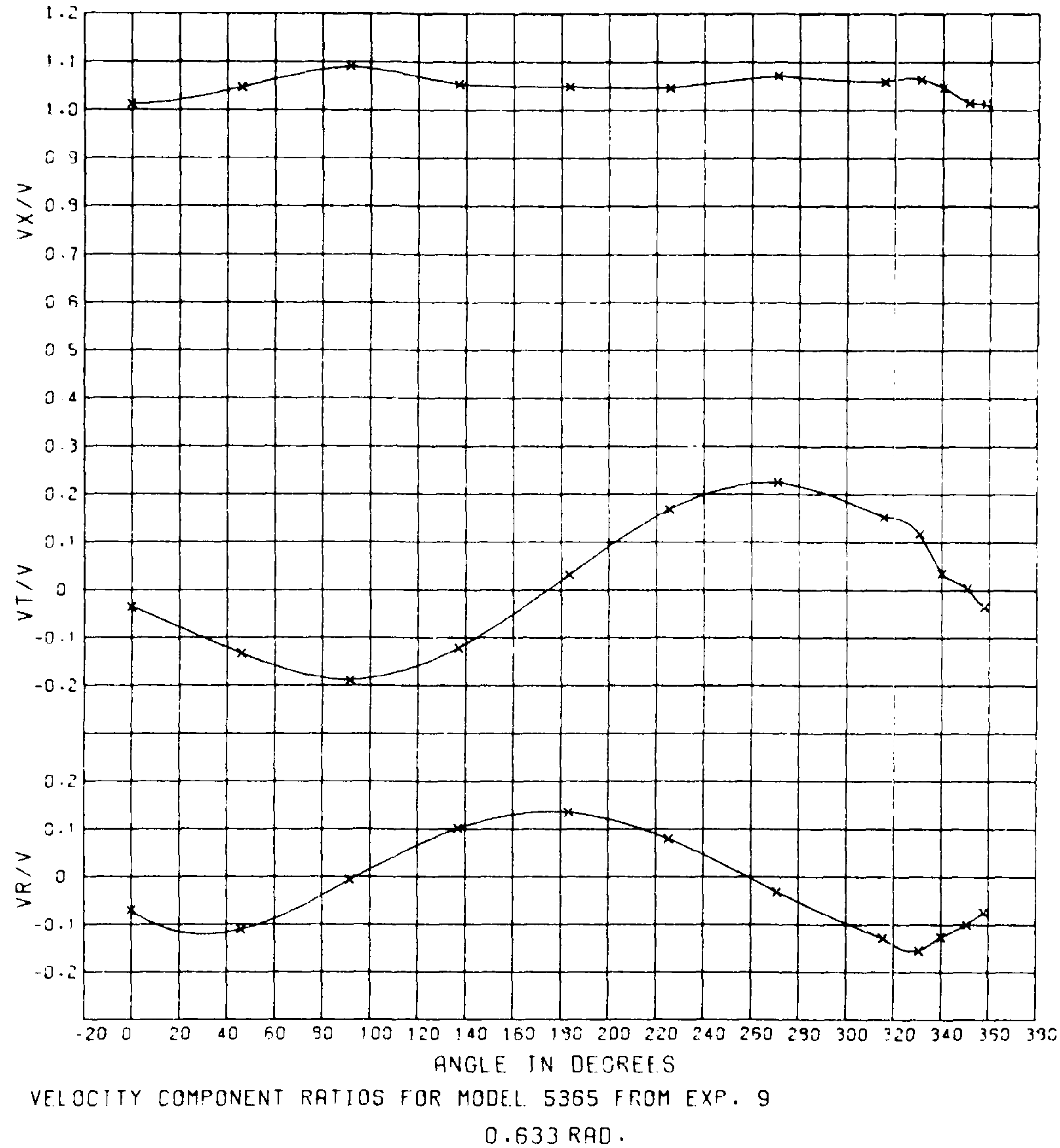


Figure A-8 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 9

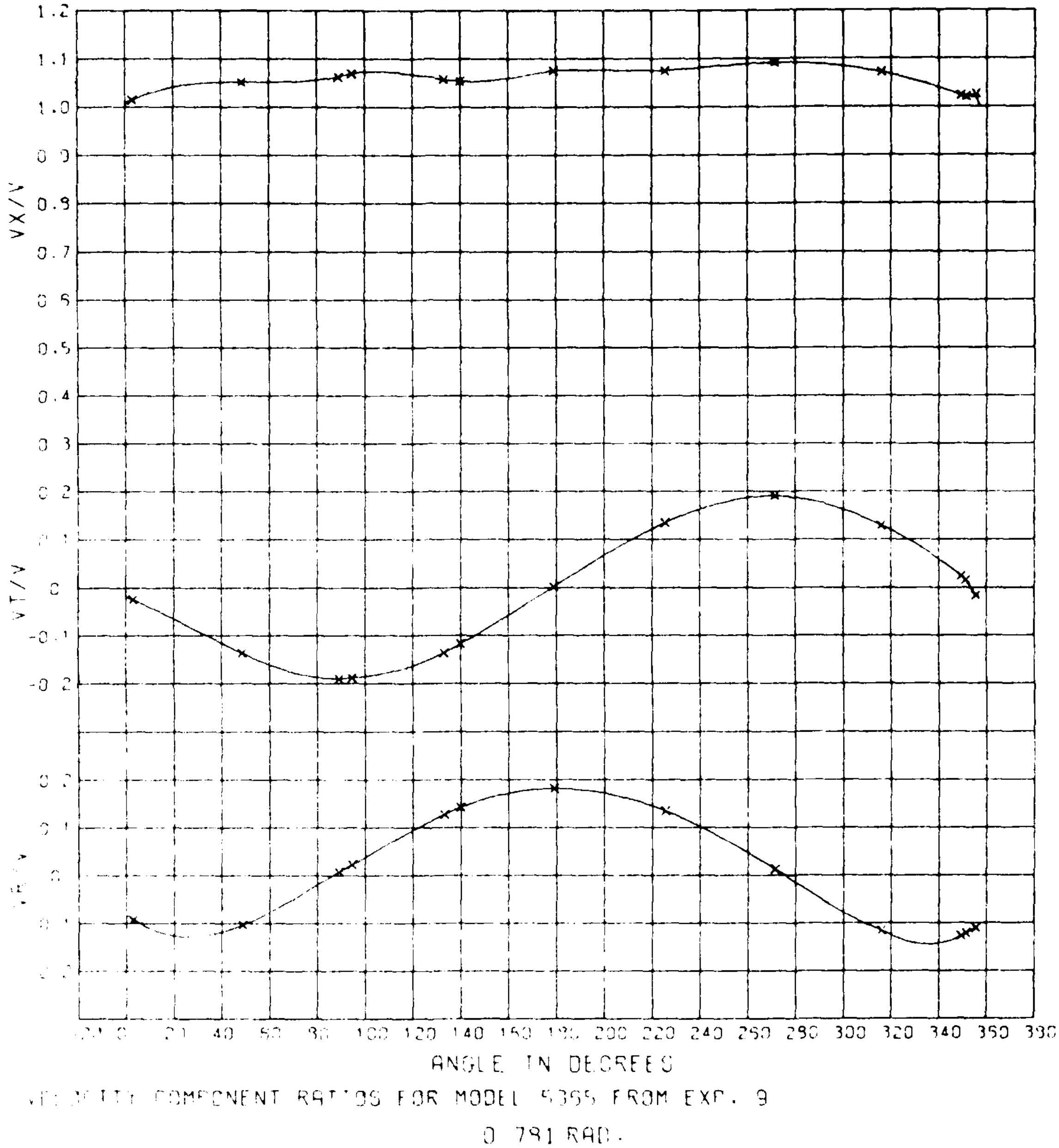


Figure A-9 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 9

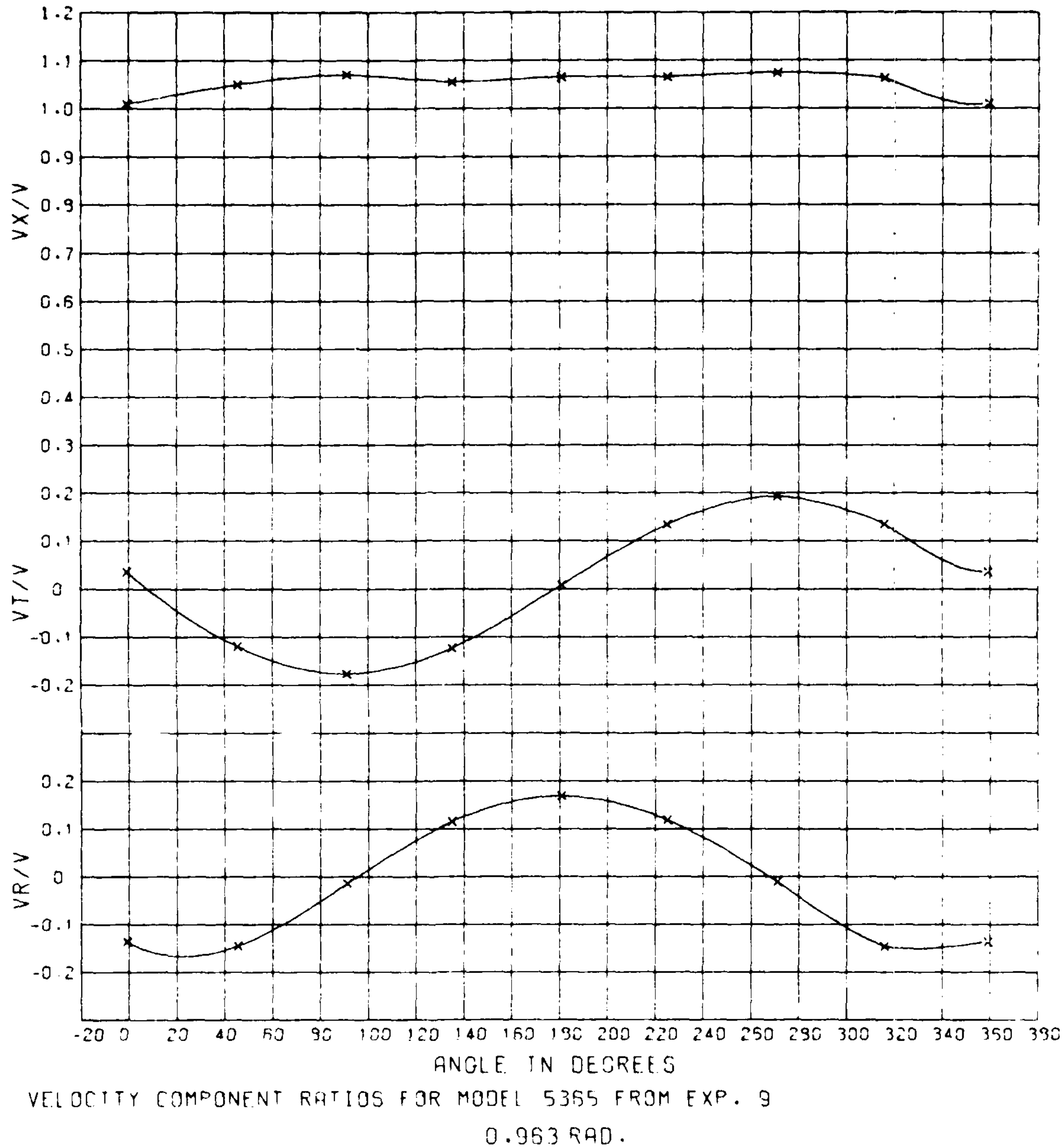


Figure A-10 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 9

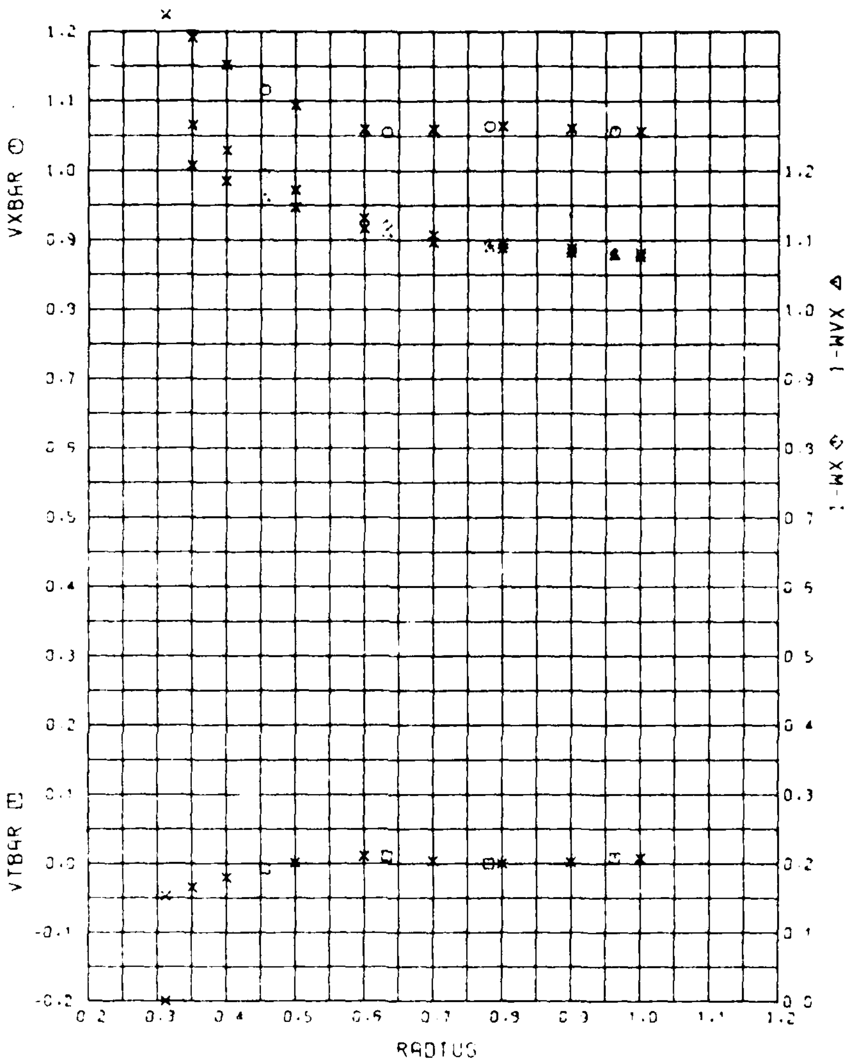


Figure A-11 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 9

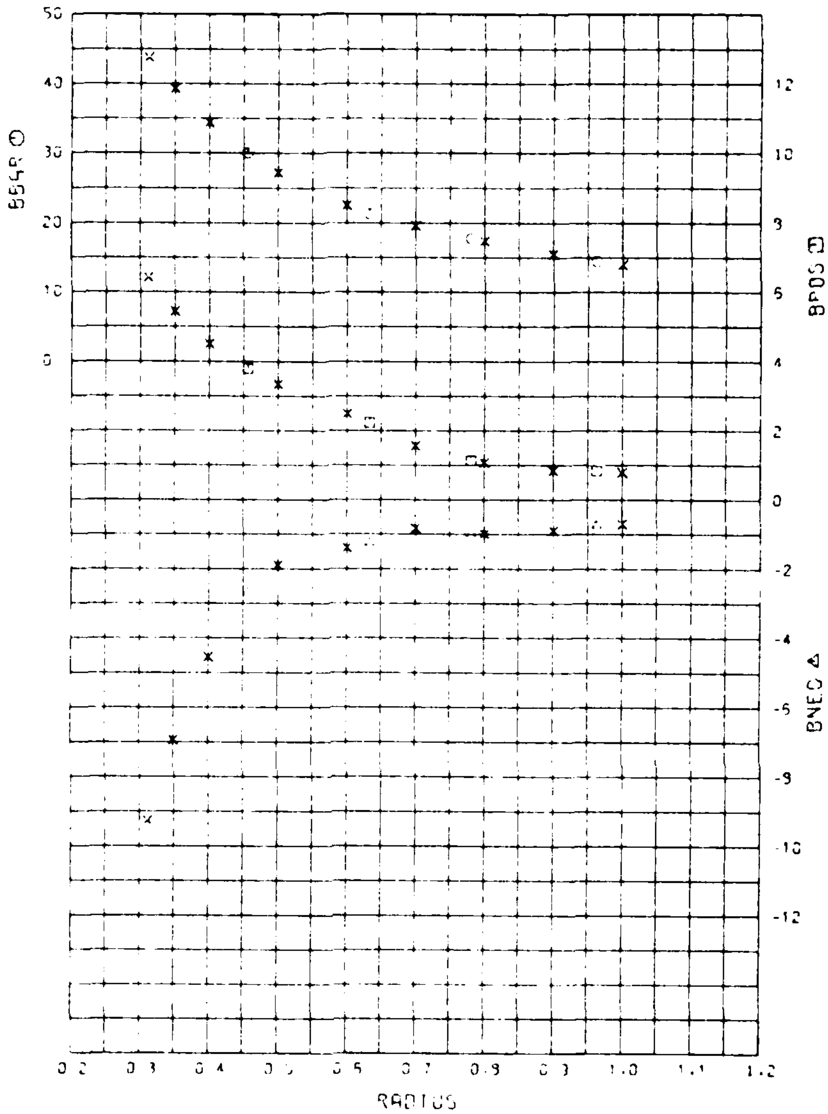


Figure A-12 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 9

TABLE A-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 3

RADIUS = .456				RADIUS = .633				RADIUS = .781				RADIUS = .963			
ANGLE	VX/V	VT/V	VR/V	ANGLE	VX/V	VT/V	VR/V	ANGLE	VX/V	VT/V	VR/V	ANGLE	VX/V	VT/V	VR/V
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE A-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

RADIUS =	.456	.623	.781	.963	.312	.350	.400	[illegible]	.600	.700	.800	.900	1.000
VXBAR =	1.126	1.057	1.080	1.052	1.259	1.217	1.169	1.[illegible]	1.062	1.073	1.080	1.069	1.052
VTBAR =	-.007	.012	-.008	.009	-.057	-.041	-.023	.002	.012	-.001	-.008	-.002	.009
VRBAR =	.003	-.008	.015	-.008	.056	.041	.023	-.000	-.009	.007	.015	.006	-.008
1-WX* =	1.180	1.119	1.097	1.086	0.000	1.237	1.210	1.[illegible]	1.128	1.107	1.098	1.093	1.086
1-WX =	1.224	1.135	1.107	1.093	0.000	1.308	1.263	1.1[illegible]	1.146	1.119	1.108	1.101	1.093
BBAR =	30.23	21.26	18.05	14.38	44.74	40.05	34.87	2[illegible]	22.51	19.82	17.65	15.61	13.87
BPOS =	3.91	2.29	1.42	.95	10.21	6.77	4.83	3.32	2.52	1.82	1.35	1.06	.90
THETA =	90.00	92.50	95.00	95.00	22.50	22.50	85.00	9[illegible].50	92.50	95.00	95.00	95.00	95.00
BNEG =	-3.83	-1.91	-2.31	-1.31	-11.67	-9.07	-6.17	-[illegible]	-2.17	-1.88	-2.32	-1.90	-1.26
THETA	0.00	335.00	332.50	332.50	0.00	0.00	0.00	33[illegible]	335.00	332.50	332.50	332.50	332.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WX* IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE A-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0367	.0358	.0284	.0190	.0143	.0099	.0050	.0026
PHASE ANGLE =	264.2	273.4	271.3	267.3	269.3	263.6	244.1	195.5
RADIUS = .633								
AMPLITUDE =	.0150	.0224	.0068	[illegible]	[illegible]	.0013	.0010	.0027
PHASE ANGLE =	323.3	268.9	[illegible]	[illegible]	262.2	[illegible]	13.3	31.2
RADIUS = .781								
AMPLITUDE =	.0103	.0147	[illegible]	.0025	.0029	.0040	.0007	.0012
PHASE ANGLE =	269.9	264.1	[illegible]	309.2	[illegible]	278.0	205.2	183.8
RADIUS = .963								
AMPLITUDE =	.0187	.0193	.0132	.0067	.0083	.0070	.0058	.0038
PHASE ANGLE =	261.6	254.1	234.9	191.4	213.7	193.4	175.5	174.1

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0044	.0058	[illegible]	.0057	[illegible]	.0030	.0009	.0019
PHASE ANGLE =	130.7	130.5	[illegible]	[illegible]	126.8	154.0	[illegible]	296.1
RADIUS = .633								
AMPLITUDE =	.0034	.0021	.0012	[illegible]	.0033	.0032	[illegible]	.0034
PHASE ANGLE =	73.2	40.2	[illegible]	[illegible]	[illegible]	261.3	[illegible]	271.8
RADIUS = .781								
AMPLITUDE =	.0007	.0027	.0019	.0016	[illegible]	.0027	.0028	.0003
PHASE ANGLE =	267.1	254.2	285.2	[illegible]	[illegible]	274.4	319.3	240.7
RADIUS = .963								
AMPLITUDE =	.0027	.0026	.0012	.0026	.0020	.0017	.0010	.0014
PHASE ANGLE =	165.9	169.4	[illegible]	260.4	205.3	298.0	133.4	43.5

TABLE A-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0900	.0499	[illegible]	[illegible]	[illegible]	.0265	.0155	[illegible]
PHASE ANGLE =	245.6	275.9	[illegible]	[illegible]	272.0	262.5	235.2	[illegible]
RADIUS = .350								
AMPLITUDE =	.0730	.0459	[illegible]	[illegible]	.0224	.0213	.0122	.0108
PHASE ANGLE =	248.7	275.3	[illegible]	[illegible]	271.4	262.6	236.5	[illegible]
RADIUS = .400								
AMPLITUDE =	.0537	.0409	.0333	.0281	.0183	.0153	.0085	.0064
PHASE ANGLE =	254.3	274.5	273.6	[illegible]	270.5	262.9	239.1	200.1
RADIUS = .500								
AMPLITUDE =	.0269	.0320	.0172	[illegible]	[illegible]	.0065	.0029	[illegible]
PHASE ANGLE =	276.0	272.4	[illegible]	[illegible]	268.0	264.9	252.4	[illegible]
RADIUS = .600								
AMPLITUDE =	.0162	.0246	.0082	.0038	.0068	.0019	.0008	.0025
PHASE ANGLE =	313.7	269.9	[illegible]	264.2	263.9	277.8	346.3	31.6
RADIUS = .700								
AMPLITUDE =	.0116	.0177	.0080	.0026	.0039	.0032	.0006	.0008
PHASE ANGLE =	312.2	267.7	268.3	307.6	268.6	291.2	348.1	41.7
RADIUS = .800								
AMPLITUDE =	.0106	.0144	[illegible]	.0023	.0029	.0040	.0010	.0015
PHASE ANGLE =	284.5	262.9	266.6	303.6	251.8	272.5	195.9	185.4
RADIUS = .900								
AMPLITUDE =	.0145	.0159	.0112	.0029	.0051	.0046	.0036	.0031
PHASE ANGLE =	265.7	256.7	[illegible]	213.3	220.8	223.6	179.6	180.9
RADIUS = 1.000								
AMPLITUDE =	.0187	.0193	[illegible]	[illegible]	.0083	.0070	.0058	.0038
PHASE ANGLE =	[illegible]	254.1	234.9	[illegible]	213.7	193.4	175.5	174.1

TABLE A-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0100	.0157	.0131	.0156	.0185	.0107	.0082	.0044
PHASE ANGLE =	152.6	159.9	130.7	128.5	116.5	122.3	71.5	65.5
RADIUS = .350								
AMPLITUDE =	.0078	.0125	.0113	.0126	.0145	.0082	.0055	.0026
PHASE ANGLE =	173.7	154.2	[illegible]	128.4	117.9	126.0	75.5	53.8
RADIUS = .400								
AMPLITUDE =	.0057	.0069	.0091	.0091	.0098	.0054	.0025	.0012
PHASE ANGLE =	156.6	145.5	130.7	[illegible]	120.6	134.1	88.2	.9
RADIUS = .500								
AMPLITUDE =	.0040	.0042	.0052	.0035	.0027	.0020	.0021	.0028
PHASE ANGLE =	110.0	113.0	131.5	129.8	140.7	188.2	226.7	262.9
RADIUS = .600								
AMPLITUDE =	.0037	.0024	.0021	.0002	.0025	.0028	.0033	.0036
PHASE ANGLE =	79.3	58.5	137.6	228.2	270.4	254.0	247.3	273.4
RADIUS = .700								
AMPLITUDE =	.0011	.0012	.0009	.0012	.0039	.0030	.0030	.0017
PHASE ANGLE =	53.8	290.5	206.4	289.2	292.8	267.2	288.6	265.6
RADIUS = .800								
AMPLITUDE =	.0009	.0029	.0020	.0017	.0036	.0026	.0027	.0001
PHASE ANGLE =	255.3	250.0	284.9	281.3	295.9	276.1	324.1	172.1
RADIUS = .900								
AMPLITUDE =	.0017	.0026	.0014	.0022	.0020	.0021	.0012	.0010
PHASE ANGLE =	201.1	217.8	264.6	268.9	270.9	287.4	349.4	64.1
RADIUS = 1.000								
AMPLITUDE =	.0027	.0026	.0012	.0026	.0020	.0017	.0010	.0014
PHASE ANGLE =	165.9	169.4	196.8	260.4	205.3	298.0	133.4	43.5

TABLE A-3 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS TO MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2359	.0054	.0027	.0040	.0046	.0036	.0034	.0031
PHASE ANGLE =	180.6	66.7	131.0	150.6	141.6	146.5	106.7	84.2
RADIUS = .633								
AMPLITUDE =	.2069	.0088	.0072	.0059	.0047	.0041	.0037	.0026
PHASE ANGLE =	183.6	289.5	[illegible]	279.2	279.7	272.4	292.2	282.0
RADIUS = .781								
AMPLITUDE =	.1932	.0037	[illegible]	.0027	.0034	.0020	.0022	.0013
PHASE ANGLE =	180.5	283.4	296.2	263.2	279.0	256.9	294.7	312.0
RADIUS = .963								
AMPLITUDE =	.1868	.0031	.0026	.0042	.0044	.0044	.0027	.0012
PHASE ANGLE =	178.5	154.7	127.2	125.1	106.3	104.2	89.7	62.6

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0050	.0045	.0062	.0051	.0042	.0026	.0012	.0010
PHASE ANGLE =	62.1	43.5	46.2	[illegible]	43.0	69.2	60.2	164.8
RADIUS = .633								
AMPLITUDE =	.0025	.0024	.0008	.0008	.0016	.0030	.0030	.0034
PHASE ANGLE =	297.0	287.0	268.2	211.6	167.1	163.9	163.1	156.5
RADIUS = .781								
AMPLITUDE =	.0019	.0008	.0002	.0006	.0013	.0018	.0014	.0015
PHASE ANGLE =	330.4	31.0	48.6	[illegible]	135.3	158.7	147.9	168.7
RADIUS = .963								
AMPLITUDE =	.0002	.0008	.0014	.0023	.0025	.0022	.0016	.0014
PHASE ANGLE =	21.0	212.2	266.4	191.3	172.3	153.9	124.6	46.0

TABLE A-6 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 3

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 3
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2717	.0308	.0212	.0213	.0196	.0165	.0161	.0137
PHASE ANGLE =	174.5	92.2	111.6	[illegible]	124.1	122.3	108.9	88.8
RADIUS = .350								
AMPLITUDE =	.2610	.0226	.0154	.0157	.0149	.0124	.0121	.0104
PHASE ANGLE =	176.3	90.2	112.8	126.2	125.6	124.5	108.7	88.5
RADIUS = .400								
AMPLITUDE =	.2483	.0134	.0087	.0095	.0095	.0077	.0076	.0066
PHASE ANGLE =	178.5	85.2	115.9	[illegible]	129.8	129.9	108.2	87.5
RADIUS = .500								
AMPLITUDE =	.2273	.0027	.0013	.0021	.0020	.0019	.0008	.0010
PHASE ANGLE =	181.9	254.3	252.7	[illegible]	177.9	192.1	97.2	69.3
RADIUS = .600								
AMPLITUDE =	[illegible]	.0080	[illegible]	.0051	.0040	.0037	.0031	.0021
PHASE ANGLE =	183.6	292.5	[illegible]	276.5	275.2	268.4	292.6	283.0
RADIUS = .700								
AMPLITUDE =	.1997	.0065	.0061	.0047	.0047	.0034	.0033	.0020
PHASE ANGLE =	182.1	289.0	291.0	275.1	279.9	268.0	291.7	292.5
RADIUS = .800								
AMPLITUDE =	.1920	.0031	.0047	.0023	.0029	.0015	.0019	.0012
PHASE ANGLE =	180.2	280.0	297.1	256.8	278.3	250.4	296.8	318.9
RADIUS = .900								
AMPLITUDE =	.1378	.0014	.0002	.0019	.0010	.0019	.0008	.0008
PHASE ANGLE =	178.3	191.9	280.3	[illegible]	117.2	117.5	60.7	24.0
RADIUS = 1.000								
AMPLITUDE =	.1868	.0031	.0026	[illegible]	[illegible]	.0044	.0027	.0012
PHASE ANGLE =	179.5	154.7	127.2	125.1	106.3	104.2	89.7	62.6

TABLE A-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R V ATHENA 3
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0169	.0162	.0180	.0154	.0136	.0096	.0079	.0047
PHASE ANGLE =	73.7	62.7	50.3	49.3	33.5	30.8	6.5	328.1
RADIUS = .350								
AMPLITUDE =	.0132	.0124	.0143	.0122	.0107	.0073	.0057	.0029
PHASE ANGLE =	72.4	60.4	49.7	49.3	34.6	35.0	11.6	326.4
RADIUS = .400								
AMPLITUDE =	.0089	.0082	.0101	.0085	.0073	.0047	.0031	.0009
PHASE ANGLE =	69.5	55.4	48.5	49.3	37.1	44.6	20.3	315.5
RADIUS = .500								
AMPLITUDE =	.0027	.0025	.0037	.0030	.0024	.0020	.0013	.0020
PHASE ANGLE =	46.4	20.5	42.5	50.4	54.5	106.1	129.8	158.0
RADIUS = .600								
AMPLITUDE =	.0020	.0022	.0005	.0003	.0013	.0028	.0028	.0033
PHASE ANGLE =	306.2	295.7	323.2	188.6	153.7	158.7	161.4	156.2
RADIUS = .700								
AMPLITUDE =	.0022	.0011	.0003	.0004	.0013	.0023	.0021	.0025
PHASE ANGLE =	314.3	321.7	324.7	154.9	146.1	162.1	159.0	164.1
RADIUS = .800								
AMPLITUDE =	.0018	.0009	.0002	.0006	.0013	.0018	.0013	.0013
PHASE ANGLE =	333.5	40.8	63.7	125.2	136.4	157.8	144.2	168.0
RADIUS = .900								
AMPLITUDE =	.0010	.0004	.0006	.0013	.0017	.0019	.0013	.0005
PHASE ANGLE =	348.9	94.4	190.3	176.1	157.3	154.4	127.1	84.8
RADIUS = 1.000								
AMPLITUDE =	.0002	.0008	.0014	.0023	.0025	.0022	.0016	.0014
PHASE ANGLE =	21.6	212.2	206.4	191.3	172.3	153.9	124.6	46.0

TABLE A-7

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 9

INPUT DATA

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.0	1.014	.023	-.010
17.6	1.003	-.098	-.076
45.2	1.122	-.168	-.084
63.6	1.121	-.217	-.053
63.6	1.124	-.216	-.058
91.1	1.137	-.241	-.007
109.0	1.132	-.228	.031
135.0	1.129	-.170	.076
155.6	1.136	-.097	.099
179.7	1.131	-.003	.111
193.0	1.136	.055	.108
224.2	1.138	.159	.081
240.0	1.145	.196	.055
269.6	1.137	.225	.002
269.7	1.145	.224	-.002
286.1	1.143	.215	-.034
315.0	1.131	.148	-.081
331.0	1.121	.116	-.093
359.0	1.014	.023	-.010
361.0	1.014	.023	-.010

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-.3	1.013	-.035	-.070
46.0	1.048	-.133	-.111
91.7	1.091	-.189	-.007
137.0	1.053	-.122	.102
137.0	1.056	-.121	.101
183.4	1.049	.032	.136
225.5	1.047	.168	.080
271.0	1.071	.225	-.032
315.7	1.059	.152	-.129
330.8	1.064	.117	-.155
340.0	1.047	.035	-.126
351.0	1.016	.005	-.101
358.0	1.014	-.035	-.074
359.7	1.013	-.035	-.070

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
2.9	1.015	-.025	-.092
48.7	1.052	-.137	-.104
89.1	1.063	-.190	.007
94.6	1.070	-.188	.023
133.2	1.058	-.136	.127
140.0	1.054	-.117	.142
179.0	1.075	.002	.182
179.0	1.076	.002	.182
225.5	1.075	.134	.135
271.4	1.092	.191	.013
316.0	1.072	.128	-.116
349.3	1.024	.025	-.127
351.3	1.020	.016	-.121
355.6	1.027	-.017	-.111
362.9	1.015	-.025	-.092

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-.5	1.011	.036	-.135
-1.0	1.009	.036	-.137
45.5	1.050	-.120	-.145
91.2	1.071	-.177	-.014
135.1	1.056	-.124	.115
180.9	1.066	.009	.169
225.1	1.066	.133	.119
271.0	1.074	.193	-.011
316.0	1.063	.135	-.146
359.0	1.009	.036	-.137
359.5	1.011	.036	-.135
360.5	1.011	.036	-.135

TABLE A-8 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	1.116	1.055	1.064	1.057	1.224	1.191	1.152	1.094	1.060	1.060	1.064	1.061	1.057
VTBAR =	-.007	.011	-.000	.008	-.047	-.034	-.020	.001	.011	.004	-.000	.002	.008
VRBAR =	.006	-.009	.016	-.008	.054	.038	.021	-.002	-.010	.007	.016	.007	-.008
1-WVX =	1.160	1.109	1.088	1.077	0.000	1.207	1.185	1.147	1.117	1.097	1.088	1.082	1.077
1-WX =	1.196	1.122	1.095	1.082	0.000	1.265	1.229	1.172	1.132	1.107	1.095	1.088	1.082
BBAR =	30.01	21.31	17.76	14.44	43.73	39.31	34.42	27.20	22.48	19.58	17.37	15.49	13.93
BPOS =	3.79	2.23	1.13	.84	6.42	5.44	4.50	3.34	2.49	1.57	1.07	.84	.79
THETA =	90.00	92.50	102.50	90.00	105.00	102.50	95.00	90.00	92.50	97.50	102.50	100.00	90.00
BNEG =	-2.69	-1.26	-.98	-.74	-9.28	-6.94	-4.55	-1.89	-1.40	-.84	-.99	-.90	-.71
THETA =	0.00	242.50	357.50	352.50	357.50	357.50	357.50	267.50	247.50	245.00	357.50	357.50	352.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE A-9 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0379	.0328	.0226	.0159	.0098	.0063	.0031	.0006
PHASE ANGLE =	254.5	256.8	247.0	237.5	236.2	221.4	179.6	24.2
RADIUS = .633								
AMPLITUDE =	.0079	.0222	.0093	.0027	.0042	.0033	.0019	.0016
PHASE ANGLE =	298.9	252.9	219.8	161.2	257.3	270.6	302.0	329.7
RADIUS = .781								
AMPLITUDE =	.0196	.0151	.0069	.0056	.0063	.0014	.0014	.0012
PHASE ANGLE =	228.3	267.9	269.9	345.6	274.0	258.9	296.3	292.3
RADIUS = .963								
AMPLITUDE =	.0165	.0167	.0095	.0029	.0033	.0015	.0009	.0005
PHASE ANGLE =	256.5	273.1	269.1	325.0	319.7	344.8	19.9	39.5

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0021	.0014	.0006	.0005	.0007	.0008	.0008	.0004
PHASE ANGLE =	47.3	17.2	44.4	92.3	135.5	133.8	128.7	132.9
RADIUS = .633								
AMPLITUDE =	.0013	.0010	.0006	.0008	.0002	.0001	.0002	.0001
PHASE ANGLE =	350.1	353.7	29.4	60.0	68.2	105.1	87.1	68.8
RADIUS = .781								
AMPLITUDE =	.0013	.0007	.0007	.0005	.0008	.0004	.0005	.0004
PHASE ANGLE =	278.3	255.3	282.7	291.9	267.3	268.9	279.7	275.9
RADIUS = .963								
AMPLITUDE =	.0002	.0001	.0003	.0001	.0003	.0002	.0001	.0001
PHASE ANGLE =	77.8	200.9	242.7	318.7	310.6	340.6	25.4	44.0

TABLE A-10 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1039	.0435	.0460	.0400	.0203	.0132	.0106	.0022
PHASE ANGLE =	242.0	265.5	264.1	254.7	235.6	196.2	163.4	134.3
RADIUS = .350								
AMPLITUDE =	.0828	.0404	.0386	.0324	.0170	.0109	.0083	.0015
PHASE ANGLE =	244.1	263.0	260.6	251.5	235.4	200.9	165.3	125.8
RADIUS = .400								
AMPLITUDE =	.0590	.0367	.0302	.0238	.0133	.0084	.0056	.0007
PHASE ANGLE =	247.9	259.9	255.0	246.1	235.3	209.0	169.5	97.8
RADIUS = .500								
AMPLITUDE =	.0254	.0300	.0180	.0110	.0076	.0051	.0017	.0009
PHASE ANGLE =	262.8	254.7	239.5	227.7	238.0	233.6	200.4	356.1
RADIUS = .600								
AMPLITUDE =	.0101	.0240	.0109	.0040	.0046	.0036	.0016	.0015
PHASE ANGLE =	293.6	252.6	222.7	185.7	250.5	263.1	292.8	334.6
RADIUS = .700								
AMPLITUDE =	.0129	.0179	.0070	.0023	.0057	.0023	.0018	.0014
PHASE ANGLE =	239.7	259.4	243.6	350.2	266.6	262.7	296.4	307.4
RADIUS = .800								
AMPLITUDE =	.0204	.0147	.0071	.0060	.0063	.0012	.0013	.0012
PHASE ANGLE =	228.1	269.6	273.5	345.0	275.9	260.6	297.9	290.6
RADIUS = .900								
AMPLITUDE =	.0197	.0150	.0085	.0054	.0048	.0008	.0008	.0005
PHASE ANGLE =	237.0	274.3	276.8	339.5	291.6	317.4	330.6	304.0
RADIUS = 1.000								
AMPLITUDE =	.0165	.0167	.0095	.0029	.0033	.0015	.0009	.0005
PHASE ANGLE =	256.5	273.1	269.1	325.0	319.7	344.8	19.9	39.5

TABLE A-10 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0035	.0012	.0003	.0014	.0016	.0016	.0015	.0008
PHASE ANGLE =	77.5	37.5	258.2	230.6	179.7	149.1	148.3	176.8
RADIUS = .350								
AMPLITUDE =	.0031	.0013	.0001	.0009	.0013	.0014	.0013	.0007
PHASE ANGLE =	70.7	30.2	334.7	222.6	171.0	145.7	143.7	167.3
RADIUS = .400								
AMPLITUDE =	.0026	.0014	.0004	.0003	.0010	.0011	.0010	.0005
PHASE ANGLE =	60.6	23.3	38.5	181.1	156.1	140.5	137.0	152.2
RADIUS = .500								
AMPLITUDE =	.0018	.0014	.0007	.0007	.0006	.0006	.0006	.0003
PHASE ANGLE =	35.5	12.8	44.4	77.3	118.6	128.0	121.5	117.7
RADIUS = .600								
AMPLITUDE =	.0014	.0011	.0007	.0009	.0004	.0002	.0003	.0002
PHASE ANGLE =	3.1	.4	36.4	64.3	83.6	112.1	100.6	84.8
RADIUS = .700								
AMPLITUDE =	.0012	.0006	.0005	.0003	.0004	.0002	.0002	.0002
PHASE ANGLE =	304.5	301.3	318.5	357.5	269.7	259.5	280.4	281.4
RADIUS = .800								
AMPLITUDE =	.0013	.0007	.0008	.0006	.0008	.0004	.0005	.0004
PHASE ANGLE =	275.1	250.4	279.2	288.2	267.7	270.4	280.3	275.9
RADIUS = .900								
AMPLITUDE =	.0007	.0005	.0006	.0005	.0006	.0003	.0003	.0002
PHASE ANGLE =	265.9	235.5	265.5	282.7	275.8	286.5	292.9	283.9
RADIUS = 1.000								
AMPLITUDE =	.0002	.0001	.0003	.0001	.0003	.0002	.0001	.0001
PHASE ANGLE =	77.8	200.9	242.7	318.7	310.6	340.6	25.4	44.0

TABLE A-11 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2333	.0027	.0030	.0039	.0046	.0028	.0022	.0014
PHASE ANGLE =	181.0	95.4	170.2	161.9	161.4	166.2	127.5	69.0
RADIUS = .633								
AMPLITUDE =	.2047	.0105	.0074	.0063	.0048	.0039	.0037	.0024
PHASE ANGLE =	184.2	281.9	271.3	263.9	275.6	303.8	334.7	.8
RADIUS = .781								
AMPLITUDE =	.1873	.0015	.0044	.0021	.0022	.0020	.0011	.0012
PHASE ANGLE =	181.3	305.1	304.[illegible]	273.6	269.7	259.4	286.7	294.9
RADIUS = .963								
AMPLITUDE =	.1813	.0025	.0037	.0032	.0023	.0022	.0022	.0017
PHASE ANGLE =	178.8	39.5	26.5	51.8	53.6	58.4	60.3	82.4

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0022	.0016	.0014	.0011	.0011	.0010	.0009	.0006
PHASE ANGLE =	70.0	63.1	83.8	95.8	109.8	114.9	115.2	119.4
RADIUS = .633								
AMPLITUDE =	.0017	.0015	.0013	.0013	.0014	.0014	.0013	.0012
PHASE ANGLE =	39.3	65.1	102.0	143.2	175.7	205.6	237.0	255.4
RADIUS = .781								
AMPLITUDE =	.0010	.0008	.0008	.0006	.0006	.0005	.0005	.0005
PHASE ANGLE =	277.9	293.1	304.5	305.1	304.1	302.0	316.8	320.9
RADIUS = .963								
AMPLITUDE =	.0013	.0008	.0005	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	103.3	101.2	98.6	93.3	88.0	78.8	71.7	89.7

TABLE A-12 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 9

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2652	.0329	.0179	.0191	.0190	.0154	.0139	.0050
PHASE ANGLE =	174.9	99.5	108.7	114.2	132.1	147.7	147.3	152.0
RADIUS = .350								
AMPLITUDE =	.2558	.0232	.0128	.0139	.0144	.0113	.0101	.0035
PHASE ANGLE =	176.8	99.4	112.9	118.2	135.1	149.0	145.8	143.6
RADIUS = .400								
AMPLITUDE =	.2446	.0124	.0071	.0082	.0091	.0068	.0059	.0020
PHASE ANGLE =	178.9	99.0	124.3	128.5	142.1	152.5	142.0	121.1
RADIUS = .500								
AMPLITUDE =	.2253	.0031	.0035	.0033	.0028	.0011	.0008	.0017
PHASE ANGLE =	182.3	284.2	232.2	215.3	201.5	232.4	36.6	35.7
RADIUS = .600								
AMPLITUDE =	.2094	.0101	.0070	.0060	.0044	.0035	.0034	.0024
PHASE ANGLE =	184.1	281.7	266.9	259.9	270.2	302.9	337.8	6.6
RADIUS = .700								
AMPLITUDE =	.1954	.0056	.0059	.0043	.0037	.0030	.0022	.0016
PHASE ANGLE =	182.8	283.7	283.5	264.9	271.2	281.8	315.2	327.9
RADIUS = .800								
AMPLITUDE =	.1859	.0010	.0041	.0016	.0019	.0018	.0009	.0011
PHASE ANGLE =	180.9	329.6	310.3	280.2	270.9	255.0	281.0	290.0
RADIUS = .900								
AMPLITUDE =	.1815	.0021	.0032	.0015	.0007	.0003	.0006	.0002
PHASE ANGLE =	179.5	53.7	355.4	39.6	25.8	79.8	65.6	71.5
RADIUS = 1.000								
AMPLITUDE =	.1813	.0025	.0037	.0032	.0023	.0022	.0022	.0017
PHASE ANGLE =	178.8	39.5	26.5	51.8	53.6	58.4	60.3	82.4

TABLE A-12 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 FROM EXP. 9
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0020	.0008	.0015	.0028	.0036	.0041	.0047	.0042
PHASE ANGLE =	130.7	320.3	350.3	6.3	33.8	55.9	76.0	84.8
RADIUS = .350								
AMPLITUDE =	.0019	.0007	.0011	.0019	.0025	.0030	.0034	.0030
PHASE ANGLE =	109.9	18.0	17.2	18.1	42.6	61.8	79.5	87.4
RADIUS = .400								
AMPLITUDE =	.0020	.0012	.0011	.0012	.0015	.0018	.0020	.0017
PHASE ANGLE =	87.0	52.6	58.6	48.5	64.6	76.3	88.0	93.8
RADIUS = .500								
AMPLITUDE =	.0022	.0019	.0016	.0013	.0012	.0010	.0006	.0004
PHASE ANGLE =	61.0	66.2	93.0	118.3	140.4	157.5	173.4	203.0
RADIUS = .600								
AMPLITUDE =	.0019	.0018	.0015	.0015	.0015	.0014	.0012	.0012
PHASE ANGLE =	45.2	66.8	101.3	139.2	170.0	199.0	230.9	250.9
RADIUS = .700								
AMPLITUDE =	.0008	.0005	.0002	.0002	.0005	.0007	.0007	.0008
PHASE ANGLE =	335.8	6.7	33.2	185.9	215.9	239.2	264.7	279.4
RADIUS = .800								
AMPLITUDE =	.0010	.0008	.0008	.0007	.0006	.0006	.0005	.0005
PHASE ANGLE =	272.4	288.7	303.0	308.3	311.6	312.3	328.0	331.3
RADIUS = .900								
AMPLITUDE =	.0003	.0003	.0004	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	207.9	273.0	309.8	331.2	343.7	359.0	20.2	33.2
RADIUS = 1.000								
AMPLITUDE =	.0013	.0008	.0005	.0004	.0004	.0004	.0004	.0004
PHASE ANGLE =	103.3	101.2	98.6	93.3	88.0	78.8	71.7	89.7

APPENDIX B

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS FOR EXPERIMENT 10

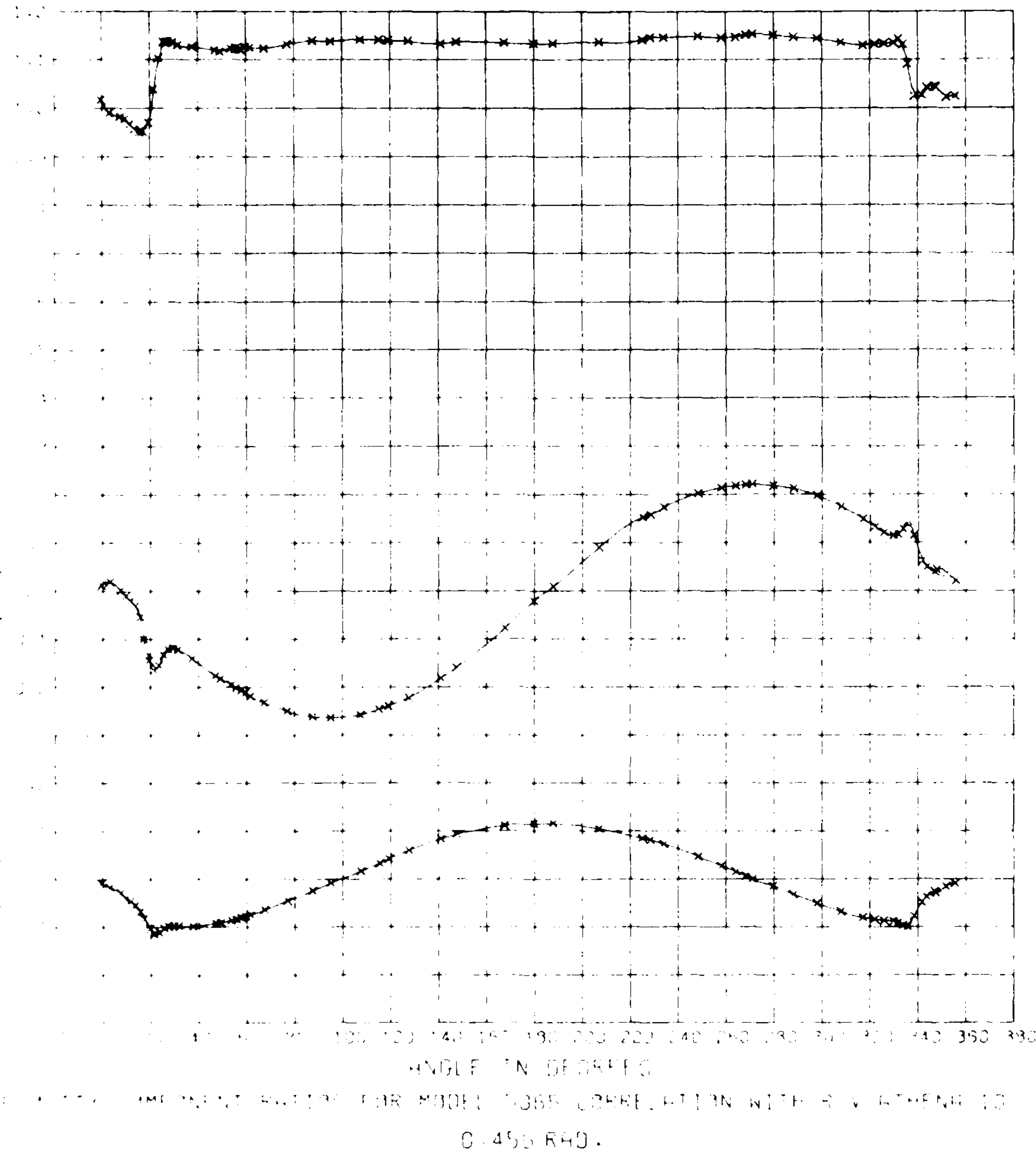


Figure 8-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 10

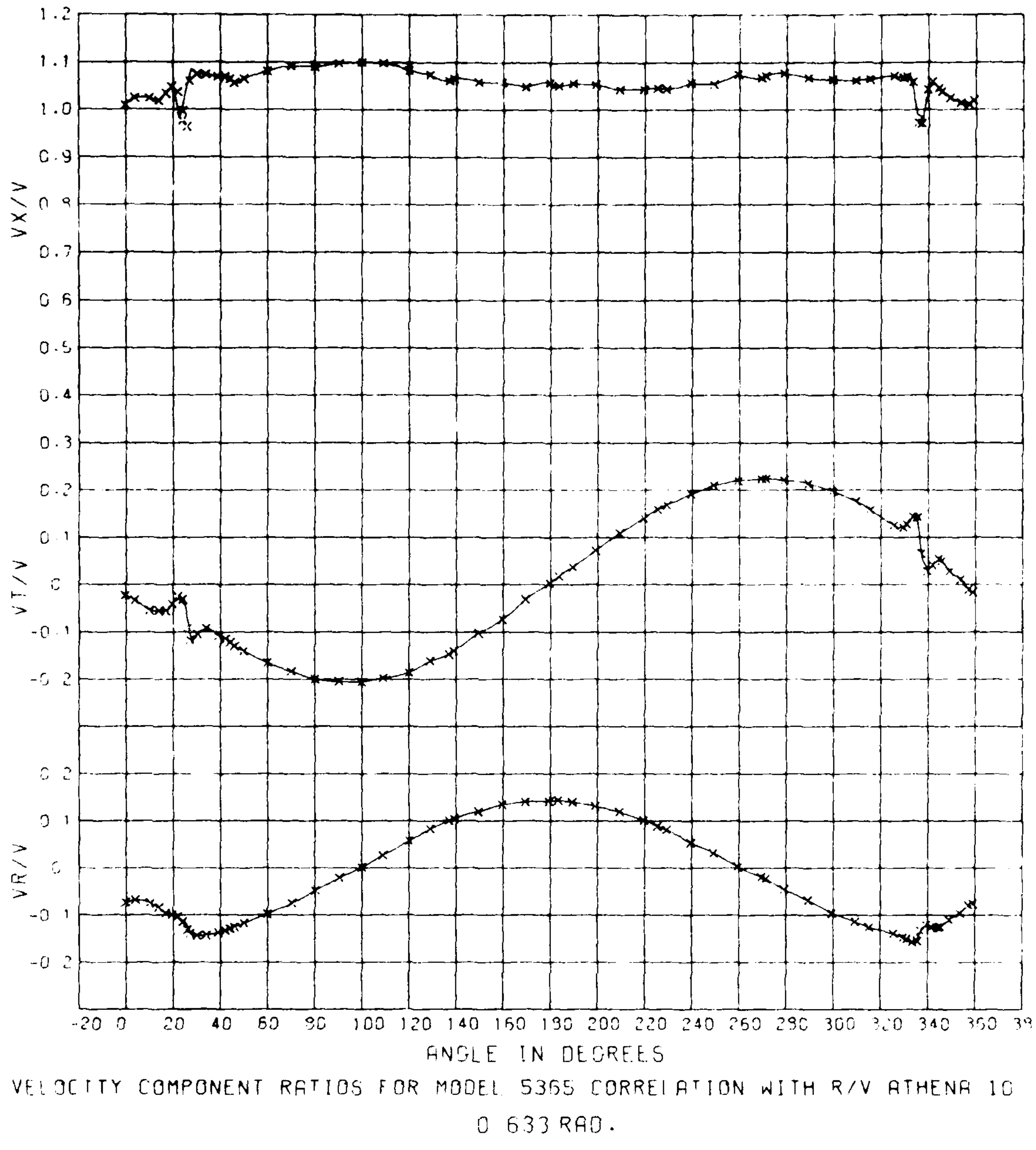


Figure B-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 10

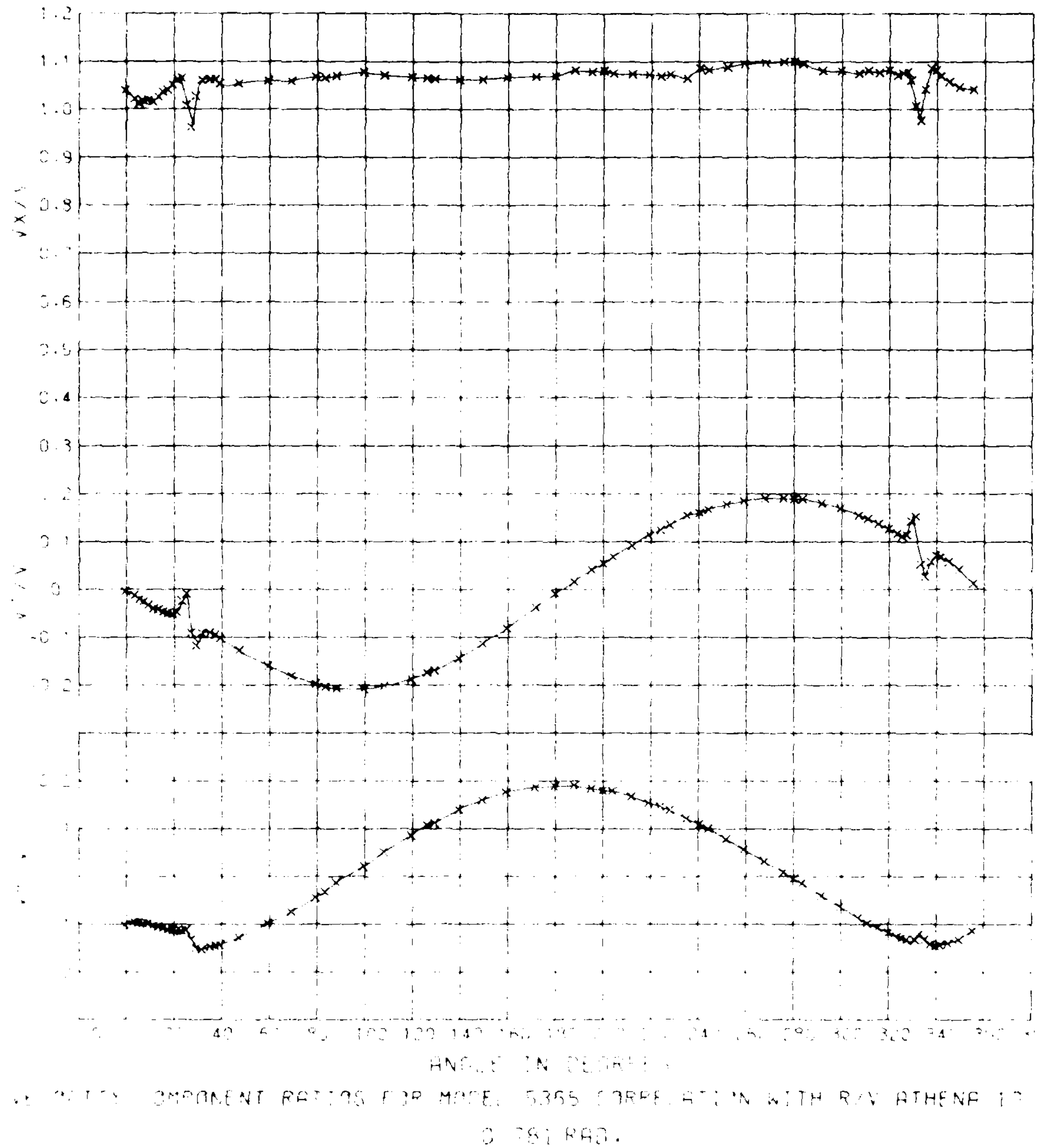
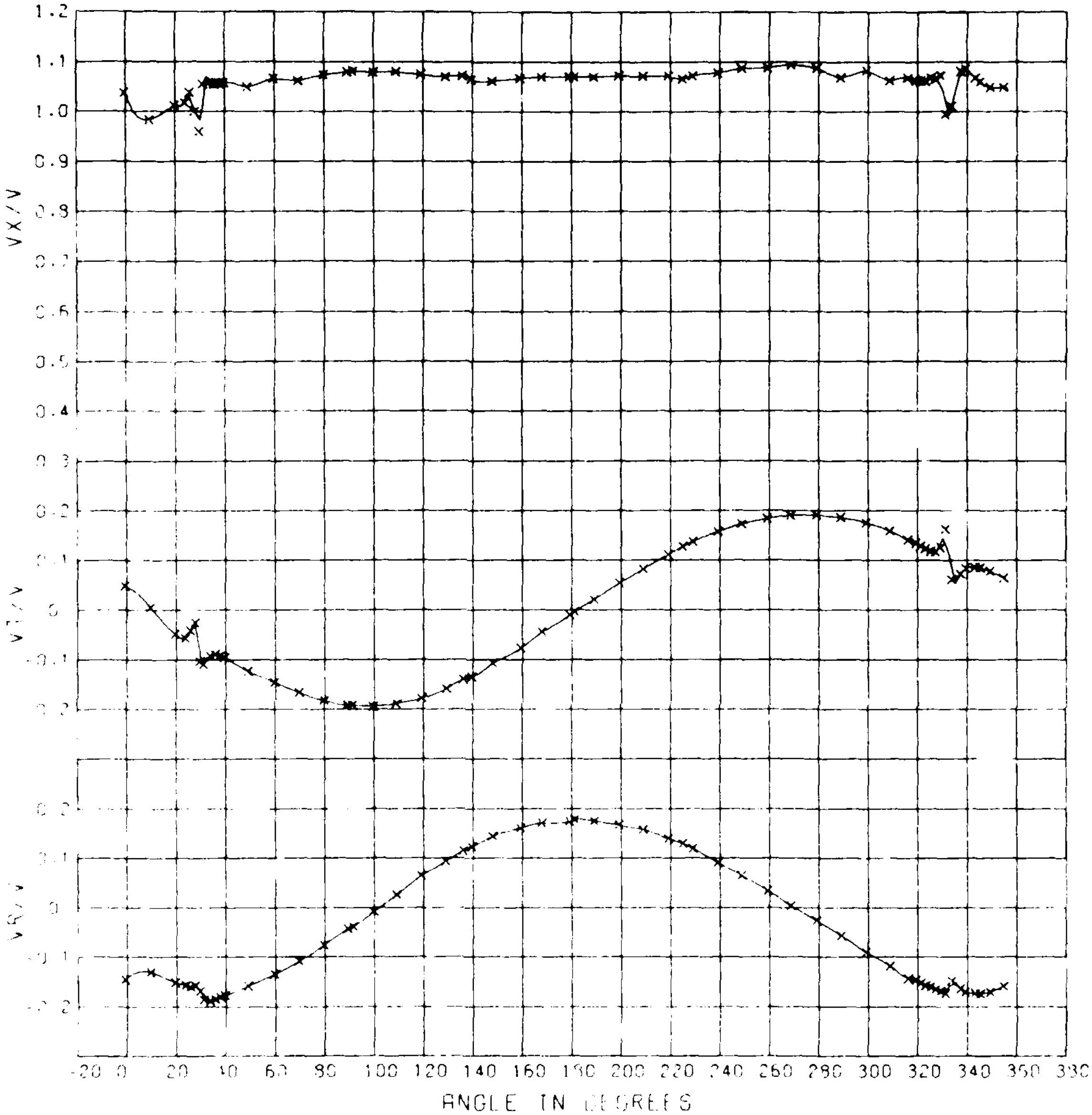


Figure B-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 10



VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 10

0.963 RAD.

Figure B-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 10

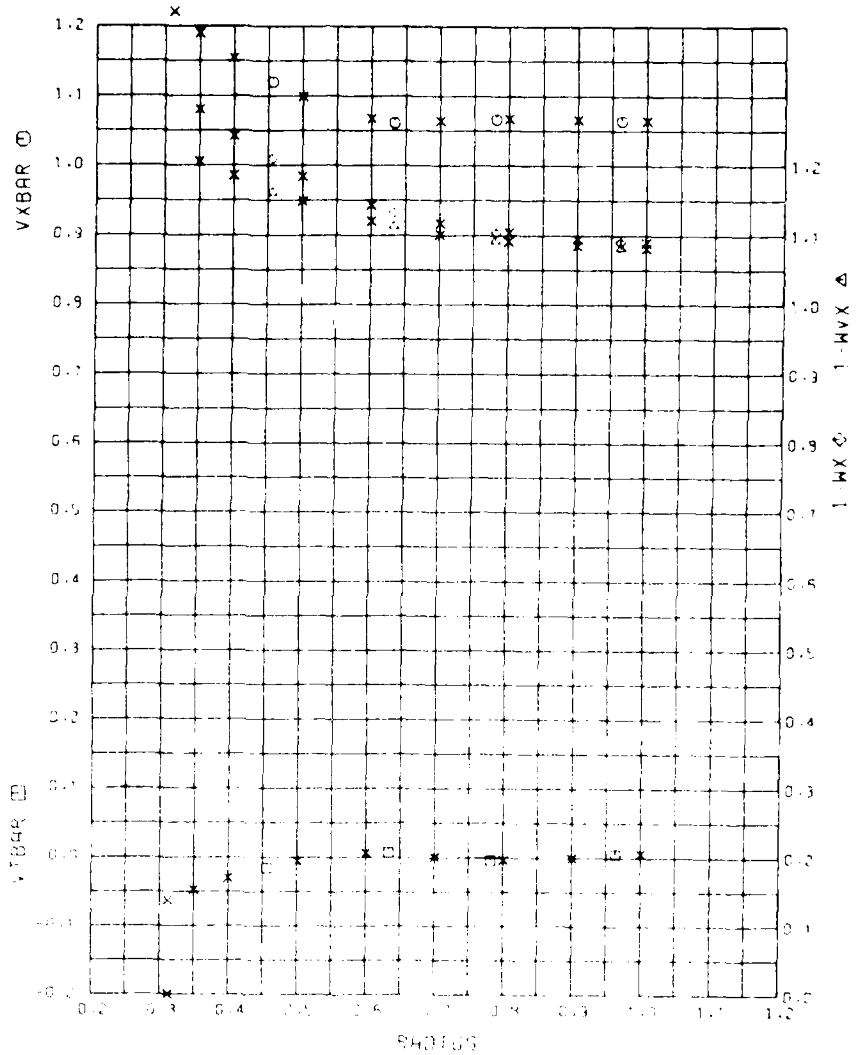


Figure B-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 10

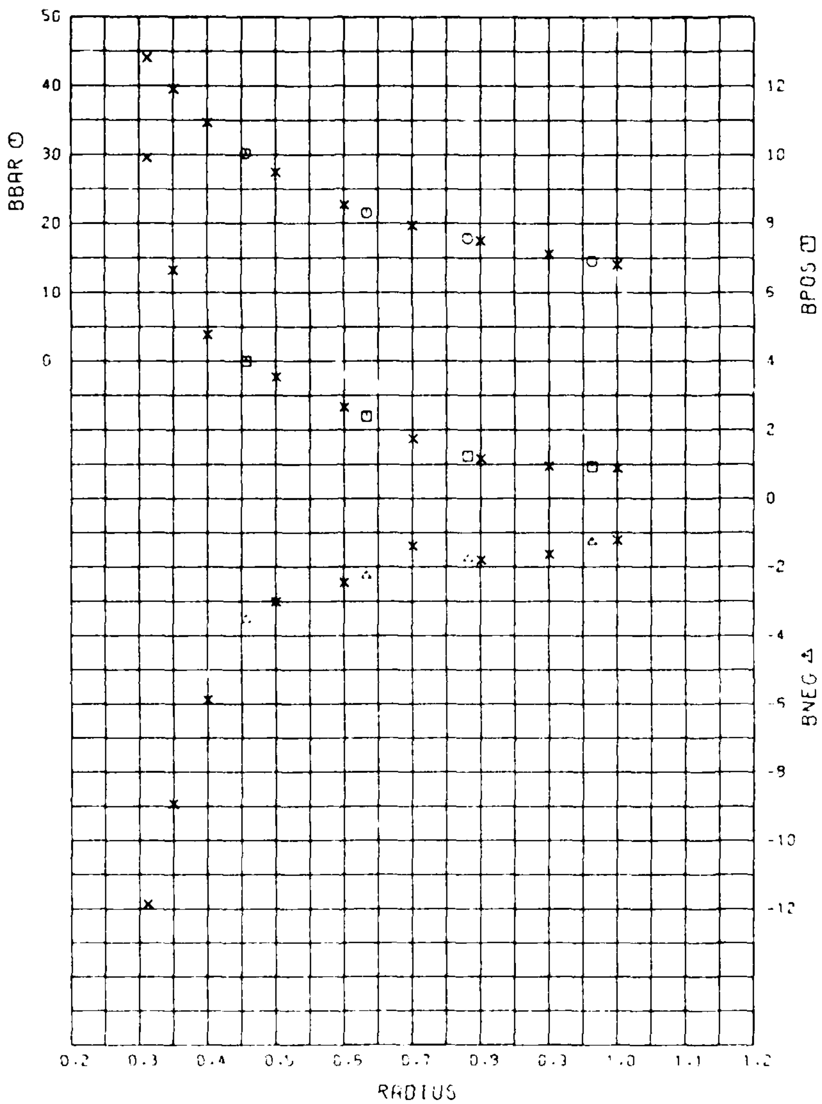


Figure B-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 10

TABLE B-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA,
MODEL 5365, EXPERIMENT 10

	RADIUS = .456		
ANGLE	VX/V	VT/V	VR/V
-.4	1.017	.012	-.009
3.0	.991	.019	-.018
7.5	.982	.002	-.028
9.5	.978	-.010	-.041
11.6	.967	-.020	-.046
13.5	.961	-.029	-.054
13.6	.955	-.032	-.054
15.5	.952	-.053	-.069
17.3	.952	-.099	-.092
19.5	.972	-.144	-.133
21.6	1.023	-.165	-.114
23.5	1.121	-.156	-.112
25.5	1.137	-.133	-.122
27.0	1.137	-.121	-.099
27.5	1.137	-.119	-.098
29.6	1.135	-.119	-.098
31.5	1.131	-.121	-.098
37.5	1.127	-.141	-.098
47.0	1.119	-.177	-.032
49.0	1.117	-.183	-.091
51.6	1.126	-.195	-.086
55.5	1.126	-.201	-.083
57.5	1.121	-.206	-.081
59.5	1.127	-.211	-.078
61.5	1.125	-.219	-.075
67.4	1.126	-.232	-.065
77.0	1.131	-.250	-.046
87.5	1.140	-.261	-.025
95.2	1.138	-.265	-.009
107.5	1.143	-.257	.016
115.3	1.142	-.246	.032
119.3	1.141	-.234	.042
127.6	1.139	-.222	.060
141.2	1.137	-.202	.083
147.6	1.137	-.160	.092
167.6	1.136	-.077	.111
179.8	1.133	-.028	.115
187.4	1.133	.009	.115
197.9	1.136	.064	.115
207.8	1.138	.091	.105
225.8	1.141	.152	.085
229.1	1.147	.158	.081
236.8	1.146	.176	.072
240.1	1.145	.202	.056
258.3	1.146	.214	.027
263.3	1.147	.217	.015
269.1	1.151	.220	.007
269.7	1.154	.220	.007
271.0	1.153	.221	-.001
279.7	1.152	.218	-.015
288.1	1.147	.212	-.033
297.1	1.144	.197	-.051
307.9	1.136	.175	-.058
317.0	1.131	.160	-.081
321.9	1.137	.133	-.086
325.8	1.136	.121	-.087
329.0	1.075	.115	-.088
331.8	1.143	.117	-.091
333.7	1.132	.128	-.097
335.7	1.031	.144	-.100
337.7	1.036	.133	-.088
339.2	1.034	.097	-.058
341.6	[illegible]	.059	-.049
341.7	1.028	.044	-.058
343.7	1.042	.043	-.038
347.3	[illegible]	.041	-.027
347.8	1.047	.036	-.026
347.6	1.043	.043	-.030
351.7	1.022	.030	-.016
355.6	1.026	.021	-.018
359.6	1.017	.012	-.009

	RADIUS = .633		
ANGLE	VX/V	VT/V	VR/V
-.3	1.039	-.023	-.073
3.6	1.025	-.032	-.068
10.0	1.026	-.055	-.074
14.0	1.017	-.055	-.093
17.8	1.036	-.056	-.136
19.0	1.049	-.041	-.121
21.1	1.049	-.040	-.099
22.1	1.036	-.025	-.102
24.3	.974	-.034	-.115
24.3	.979	-.031	-.115
24.1	.996	-.031	-.114
26.3	.956	-.092	-.131
26.8	.971	-.092	-.133
27.0	1.054	-.117	-.139
30.0	1.075	-.105	-.145
30.1	1.073	-.105	-.145
34.8	1.073	-.092	-.143
39.0	1.068	-.109	-.137
42.1	1.063	-.115	-.133
44.1	1.064	-.122	-.124
46.3	1.056	-.130	-.125
50.0	1.065	-.148	-.117
60.0	[illegible]	-.165	-.098
70.1	1.091	-.184	-.075
80.2	1.085	-.200	-.068
80.2	1.091	-.240	-.049
89.7	1.095	-.204	-.025
91.0	1.098	-.205	-.019
100.0	1.099	-.206	.002
109.8	1.099	-.198	.026
126.0	1.093	-.186	.057
129.8	1.075	-.160	.081
137.0	1.061	-.147	.103
139.8	1.065	-.140	.104
149.6	1.058	-.103	.119
159.6	1.058	-.074	.134
169.6	1.049	-.031	.139
179.5	1.057	.003	.141
181.6	1.051	.018	.143
189.6	1.056	.037	.140
199.0	1.053	.073	.131
209.1	1.061	.109	.119
219.5	1.064	.141	.101
225.3	1.060	.154	.089
229.2	1.044	.169	.081
239.5	1.056	.192	.051
249.2	1.054	.209	.032
259.5	1.074	.219	.023
269.4	1.068	.224	-.026
271.2	1.072	.224	-.024
279.8	1.077	.221	-.046
289.2	1.066	.214	-.068
299.5	1.063	.197	-.096
309.1	1.061	.176	-.114
315.1	1.066	.159	-.125
324.5	1.071	.126	-.139
329.5	1.066	.121	-.146
329.5	1.067	.119	-.148
331.0	1.070	.127	-.154
333.4	1.061	.142	-.158
333.5	1.055	.145	-.156
335.5	.973	.142	-.154
337.0	.971	.066	-.133
339.5	1.042	.028	-.121
341.6	1.058	.041	-.126
343.4	1.068	.055	-.127
345.0	1.063	.054	-.126
345.6	1.038	.050	-.126
349.0	1.025	.029	-.109
353.7	1.015	.017	-.096
357.0	1.011	-.011	-.079
359.3	1.017	-.017	-.076
359.3	1.021	-.015	-.075
359.7	1.039	-.023	-.073

	RADIUS = .781		
ANGLE	VX/V	VT/V	VR/V
-.5	[illegible]	-.004	-.122
3.3	[illegible]	-.013	-.045
5.3	[illegible]	-.021	-.097
7.0	[illegible]	-.025	-.099
9.2	[illegible]	-.032	-.113
11.3	[illegible]	-.040	-.105
13.3	[illegible]	-.041	-.108
13.3	[illegible]	-.047	-.112
15.3	[illegible]	-.051	-.113
17.3	[illegible]	-.064	-.114
17.3	[illegible]	-.052	-.112
19.3	[illegible]	-.050	-.114
19.5	[illegible]	-.064	-.114
21.7	[illegible]	-.025	-.116
23.2	[illegible]	[illegible]	-.117
27.2	[illegible]	[illegible]	-.133
27.2	[illegible]	-.118	-.151
29.0	[illegible]	-.096	-.151
31.2	[illegible]	-.087	-.151
32.6	[illegible]	-.090	-.149
35.1	[illegible]	-.096	-.145
37.2	[illegible]	-.103	-.143
39.7	[illegible]	-.128	-.128
47.1	[illegible]	-.162	-.099
59.4	[illegible]	-.180	-.074
69.1	[illegible]	-.197	-.067
79.1	[illegible]	-.190	-.044
79.6	[illegible]	-.204	-.013
83.3	[illegible]	-.207	-.013
88.3	[illegible]	-.204	[illegible]
99.4	[illegible]	-.202	[illegible]
109.0	[illegible]	-.187	[illegible]
119.5	[illegible]	-.176	[illegible]
126.3	[illegible]	-.164	[illegible]
129.2	[illegible]	-.113	[illegible]
139.5	[illegible]	-.081	[illegible]
149.3	[illegible]	-.030	[illegible]
159.5	[illegible]	-.004	[illegible]
171.5	[illegible]	[illegible]	[illegible]
179.7	[illegible]	[illegible]	[illegible]
187.6	[illegible]	[illegible]	[illegible]
199.3	[illegible]	[illegible]	[illegible]
202.0	[illegible]	[illegible]	[illegible]
203.9	[illegible]	[illegible]	[illegible]
211.0	[illegible]	[illegible]	[illegible]
219.0	[illegible]	[illegible]	[illegible]
223.4	[illegible]	[illegible]	[illegible]
227.4	[illegible]	[illegible]	[illegible]
235.3	[illegible]	[illegible]	[illegible]
240.7	[illegible]	.193	[illegible]
243.4	[illegible]	.167	.100
251.9	[illegible]	.177	.079
259.2	[illegible]	.186	.056
267.9	[illegible]	.190	.037
275.5	[illegible]	.190	.020
283.1	[illegible]	.189	-.025
283.6	[illegible]	.183	-.026
291.7	[illegible]	.190	-.041
299.5	[illegible]	.178	-.066
307.0	[illegible]	.155	-.086
311.3	[illegible]	.143	-.104
315.5	[illegible]	.137	-.127
319.0	[illegible]	.126	-.114
323.4	[illegible]	.115	-.126
325.4	[illegible]	.112	-.128
327.4	[illegible]	.115	-.133
329.0	[illegible]	.143	-.144
331.0	[illegible]	.152	-.133
333.0	[illegible]	.052	-.119
335.3	[illegible]	.027	-.137
337.4	[illegible]	.050	-.162
339.6	[illegible]	.071	-.165
341.4	[illegible]	.066	-.143
345.3	[illegible]	.059	-.133
349.4	[illegible]	.041	-.133
355.3	[illegible]	.013	-.115
359.5	[illegible]	-.004	-.107

	RADIUS = .963		
ANGLE	VX/V	VT/V	VR/V
-.7	1.037	.040	-.149
9.5	.987	.005	-.130
19.6	1.032	-.040	-.151
23.7	1.017	-.057	-.156
25.7	1.039	-.041	-.160
27.6	1.006	-.023	-.156
27.7	.992	-.027	-.158
29.5	.952	-.099	-.160
29.7	.967	-.107	-.160
31.0	1.055	-.110	-.186
33.6	1.047	-.091	-.189
35.7	1.055	-.089	-.185
37.8	1.054	-.092	-.181
39.6	1.047	-.097	-.177
49.3	1.049	-.124	-.158
59.7	1.066	-.146	-.134
69.5	1.061	-.167	-.109
79.8	1.073	-.182	-.076
89.3	1.079	-.192	-.044
91.3	1.081	-.198	-.040
91.4	1.077	-.193	-.038
99.8	1.078	-.199	-.009
109.0	1.078	-.189	.025
109.8	1.081	-.190	.026
119.3	1.074	-.170	.064
129.1	[illegible]	-.159	.083
136.2	1.071	-.140	.115
139.5	1.064	-.135	.123
148.3	1.061	-.107	.144
159.3	1.067	-.077	.161
168.0	1.069	-.044	.172
179.7	[illegible]	-.010	.174
181.0	[illegible]	-.004	.178
189.3	[illegible]	.021	.175
199.2	1.072	.054	.167
208.9	1.071	.082	.157
219.1	1.071	.111	.133
224.8	1.067	.127	.129
228.9	1.072	.137	.119
239.1	1.078	.157	.031
248.7	1.086	.173	.065
259.2	1.088	.184	.036
268.7	1.093	.190	.024
279.1	1.087	.191	-.026
288.4	1.068	.186	-.057
299.2	1.082	.176	-.091
308.8	1.062	.159	-.118
316.0	1.067	.141	-.165
319.2	1.062	.134	-.167
321.2	1.062	.128	-.157
323.2	1.061	.126	-.157
325.2	1.044	.118	-.159
327.2	1.065	.116	-.164
329.2	1.072	.126	-.168
331.2	.994	.163	-.173
333.7	.966	.089	-.165
336.8	1.056	.037	-.169
337.7	1.041	.072	-.166
339.2	1.044	.086	-.172
343.1	1.067	.088	-.173
345.2	1.053	.085	-.176
349.2	1.049	.070	-.178
354.8	1.051	.063	-.158
355.2	1.045	.065	-.159
359.3	1.037	.040	-.169

TABLE B-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 10

[illegible] ION OF [illegible] VELOCITY COMPONENT RATI[illegible] [illegible] 53[illegible] CORRELATION WITH R / ATHENA 10
PROPELLER DIA [illegible] [illegible] FEET JA = .73[illegible]

[illegible]	[illegible]	[illegible]	.781	.963	[illegible]	.350	.400	[illegible]	.600	.700	.800	.900	1.000
[illegible]	[illegible]	[illegible]	1.066	1.067	[illegible]	1.190	[illegible]	[illegible]	1.067	1.064	1.067	1.066	1.064
[illegible]	[illegible]	.007	-.004	.005	[illegible]	-.048	[illegible]	[illegible]	.000	-.000	-.004	-.001	.005
[illegible]	[illegible]	[illegible]	.016	-.010	[illegible]	.035	[illegible]	[illegible]	-.009	.008	.016	.005	-.010
[illegible]	[illegible]	[illegible]	1.092	1.082	[illegible]	1.205	[illegible]	[illegible]	1.120	1.101	1.091	1.055	1.081
[illegible]	[illegible]	1.133	1.104	1.095	0.000	1.290	1.242	[illegible]	1.143	1.117	1.104	1.095	1.089
[illegible]	[illegible]	21.46	17.62	14.54	44.01	39.56	[illegible]	[illegible]	22.64	[illegible]	17.43	15.56	14.02
[illegible]	[illegible]	2.39	1.24	.93	[illegible]	6.65	[illegible]	[illegible]	[illegible]	1.74	1.16	.94	.88
[illegible]	[illegible]	100.00	97.50	95.00	[illegible]	22.50	[illegible]	[illegible]	100.00	100.00	97.50	97.50	95.00
[illegible]	[illegible]	[illegible]	-1.77	-1.27	[illegible]	-8.93	[illegible]	[illegible]	-2.46	-1.33	-1.60	-1.63	-1.22
[illegible]	[illegible]	[illegible]	332.50	332.50	[illegible]	5.00	[illegible]	[illegible]	335.00	332.50	332.50	332.50	332.50

UXBAR IS [illegible] CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS [illegible] CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
[illegible] IS [illegible] CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
[illegible] WAKE VELOCITY [illegible] TANGENTIAL [illegible]
[illegible] VELOCITY WITH TANGENTIAL [illegible]
[illegible] ANGLE OF ADVANCE.
[illegible] BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLE [illegible] ETA [illegible]
[illegible] BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLE [illegible] ETA [illegible]
[illegible] ANGLE IN DEGREES AT WHICH [illegible]

TABLE B-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 10

[illegible]

[illegible]

HARMONIC =	[illegible]	2	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.0348	[illegible]	[illegible]	[illegible]	[illegible]	.0070	[illegible]
PHASE ANGLE =	[illegible]	263.2	[illegible]	[illegible]	[illegible]	[illegible]	270.2	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.0229	[illegible]	[illegible]	[illegible]	.0032	.0007	[illegible]
PHASE ANGLE =	[illegible]	259.9	[illegible]	[illegible]	[illegible]	274.6	307.5	2.3
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0018	.0021	.0014
PHASE ANGLE =	[illegible]	257.4	[illegible]	[illegible]	[illegible]	243.8	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0053	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	255.5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS [illegible]

HARMONIC =	[illegible]	10	[illegible]	[illegible]	[illegible]	[illegible]	15	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS = .633								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.0027	[illegible]	[illegible]	[illegible]	.0027	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	206.5	[illegible]	[illegible]	[illegible]	274.0	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	.0033	[illegible]	[illegible]	[illegible]	[illegible]	.0023	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE B-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 10

VELOCITY COMPONENT RATIOS FOR MODEL 5365 CORRELATION WITH R/V ATHENA 10
PROPELLER DIAMETER 5.50 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1100	.0458	.0428	.0435	.0272	.0248	.0187	.0143
PHASE ANGLE =	236.3	265.9	[illegible]	[illegible]	249.4	228.0	203.4	175.6
RADIUS = .350								
AMPLITUDE =	.0859	.0428	[illegible]	.0357	.0235	.0206	.0151	.0112
PHASE ANGLE =	259.6	265.2	268.8	[illegible]	251.4	230.0	210.5	[illegible]
RADIUS = .400								
AMPLITUDE =	.0593	.0380	[illegible]	.0265	.0192	.0157	.0109	.0077
PHASE ANGLE =	[illegible]	264.3	[illegible]	259.5	254.3	233.5	214.2	176.9
RADIUS = .500								
AMPLITUDE =	.0246	.0316	.0175	.0122	.0122	.0083	.0046	.0025
PHASE ANGLE =	275.0	262.5	254.1	[illegible]	260.4	244.8	227.5	180.1
RADIUS = .600								
AMPLITUDE =	.0148	.0250	[illegible]	.0031	.0073	.0040	.0012	.0003
PHASE ANGLE =	327.5	260.5	[illegible]	[illegible]	263.7	266.4	270.4	349.8
RADIUS = .700								
AMPLITUDE =	.0089	.0176	[illegible]	.0017	.0047	.0024	.0007	.0005
PHASE ANGLE =	[illegible]	259.0	[illegible]	39.1	243.9	271.6	116.0	85.3
RADIUS = .800								
AMPLITUDE =	[illegible]	.0140	[illegible]	.0022	.0047	.0019	.0024	.0017
PHASE ANGLE =	[illegible]	257.0	[illegible]	[illegible]	215.7	233.5	136.6	147.1
RADIUS = .900								
AMPLITUDE =	.0204	.0155	[illegible]	.0031	.0063	[illegible]	.0010	.0037
PHASE ANGLE =	[illegible]	255.6	[illegible]	[illegible]	206.3	196.8	154.8	161.9
RADIUS = 1.000								
AMPLITUDE =	.0185	.0190	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	246.8	255.5	[illegible]	[illegible]	211.1	189.6	[illegible]	167.0

TABLE B-4 (Continued)

[illegible] COMPONENT RATIO [illegible] 5365 CORRELATION WITH [illegible] ATHENA 10
PROPELLER DIA [illegible] [illegible] FEET JA = .75

HARMONIC ANALYSES OF LONGITUDINAL [illegible] COMPONENT RATIOS [illegible]

HARMONIC =	9	10	[illegible]	[illegible]	[illegible]	14	15	[illegible]
RADIUS = .312								
AMPLITUDE =	[illegible]	.0108	[illegible]	[illegible]	[illegible]	.0141	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	98.1	[illegible]	[illegible]
RADIUS = .350								
AMPLITUDE =	[illegible]	.0097	[illegible]	[illegible]	[illegible]	.0111	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	138.0	[illegible]	[illegible]	[illegible]	97.3	[illegible]	[illegible]
RADIUS = .400								
AMPLITUDE =	[illegible]	.0063	.0108	[illegible]	[illegible]	.0075	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	130.4	114.8	107.7	[illegible]	95.7	81.0	[illegible]
RADIUS = .500								
AMPLITUDE =	[illegible]	.0062	[illegible]	[illegible]	[illegible]	.0021	[illegible]	.0025
PHASE ANGLE =	[illegible]	117.1	[illegible]	100.7	[illegible]	83.9	[illegible]	306.1
RADIUS = .600								
AMPLITUDE =	[illegible]	.0042	[illegible]	[illegible]	.0012	.0016	.0030	.0039
PHASE ANGLE =	137.6	111.5	[illegible]	[illegible]	[illegible]	296.3	292.1	292.1
RADIUS = .700								
AMPLITUDE =	.0027	.0020	[illegible]	[illegible]	[illegible]	.0025	.0020	[illegible]
PHASE ANGLE =	[illegible]	160.4	[illegible]	[illegible]	[illegible]	283.3	[illegible]	291.9
RADIUS = .800								
AMPLITUDE =	.0024	.0029	.0030	[illegible]	[illegible]	.0027	.0011	.0001
PHASE ANGLE =	[illegible]	210.3	[illegible]	[illegible]	[illegible]	277.0	[illegible]	[illegible]
RADIUS = .900								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	.0023	.0026	.0012	[illegible]
PHASE ANGLE =	[illegible]	211.5	[illegible]	[illegible]	[illegible]	272.3	273.8	97.2
RADIUS = 1.000								
AMPLITUDE =	[illegible]	.0033	[illegible]	[illegible]	.0017	.0023	.0020	[illegible]
PHASE ANGLE =	[illegible]	199.0	[illegible]	[illegible]	224.6	269.3	[illegible]	93.4

TABLE B-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 10

[illegible] COMPONENT RAT[illegible] 53[illegible] CORRELATION WITH R [illegible] ATH[illegible]NA 10
PROPELLER DIA[illegible] [illegible].0 FEET JA = [illegible]

HARMONIC ANALYSES OF TANGENTIAL [illegible] COMPONENT RATIOS (VT [illegible])

HARMONIC =	1	2	[illegible]	4	5	6	7	8
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.00[illegible]	[illegible]	[illegible]	.003[illegible]	.0037	.0026	.00[illegible]
PHASE ANGLE =	[illegible]	54.8	1[illegible]0	[illegible]	1[illegible].7	134.3	[illegible]3.4	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.00[illegible]1	[illegible]	[illegible]	.0041	.0029	.0027	.00[illegible]
PHASE ANGLE =	[illegible].7	30[illegible].2	2[illegible]	[illegible]	281.8	273.5	283.2	292.[illegible]
RADIUS = .781								
AMPLITUDE =	.1956	.005[illegible]	[illegible]	[illegible]	.001[illegible]	.0007	.0014	.00[illegible]
PHASE ANGLE =	[illegible]6.8	21.7	3[illegible]	[illegible]	28[illegible].0	255.3	287.[illegible]	2[illegible].7
RADIUS = .9[illegible]								
AMPLITUDE =	[illegible]	.0071	[illegible]	[illegible]32	.003[illegible]	.0035	.002[illegible]	.0020
PHASE ANGLE =	[illegible]74.2	68.4	[illegible]	11[illegible].2	9[illegible].0	105.7	1[illegible]5.4	96.6

HARMONIC ANALYSES OF TANGENTIAL [illegible] COMPONENT RATIOS (VT [illegible])

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0046	.0057	[illegible]	[illegible]	.00[illegible]	.0036	.0022	.0014
PHASE ANGLE =	30.1	35.0	[illegible]	[illegible]	11.[illegible]	359.3	340.[illegible]	2[illegible]5.2
RADIUS = .633								
AMPLITUDE =	.0019	.0006	[illegible]2	[illegible]12	.0020	.0035	.0030	.0033
PHASE ANGLE =	[illegible].4	292.8	2[illegible]	[illegible].5	163.[illegible]	160.2	159.0	163.7
RADIUS = .781								
AMPLITUDE =	.00[illegible]	.0011	[illegible]	[illegible]	.0024	.0020	.0012	.0006
PHASE ANGLE =	[illegible].5	181.6	[illegible]	[illegible]	1[illegible].9	192.2	191.5	247.2
RADIUS = .963								
AMPLITUDE =	.0013	.0013	[illegible]	[illegible]	.001[illegible]	.0010	.00[illegible]	.0005
PHASE ANGLE =	163.7	117.7	[illegible]	[illegible]	15[illegible].3	180.0	221.[illegible]	2[illegible]5.0

TABLE B-6 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 10

[illegible]

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS [illegible]

HARMONIC	[illegible]	2	[illegible]	[illegible]	5	6	7	8
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0156	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	118.4	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	.0133	[illegible]	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	123.7	120.1	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	.0083	.0076	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	123.8	[illegible]	[illegible]
RADIUS = .500								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	.0016	.0016	.0007	[illegible]
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	181.9	163.9	[illegible]	[illegible]
RADIUS = [illegible]								
AMPLITUDE =	[illegible]	.0067	[illegible]	[illegible]	[illegible]	.0025	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	310.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS = .700								
AMPLITUDE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0020	[illegible]	.0014
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS = .800								
AMPLITUDE =	[illegible]	.0042	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0005
PHASE ANGLE =	[illegible]	28.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS = .900								
AMPLITUDE =	[illegible]	.0071	[illegible]	[illegible]	[illegible]	.0019	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	54.0	[illegible]	[illegible]	[illegible]	109.8	102.2	[illegible]
RADIUS = 1.000								
AMPLITUDE =	[illegible]	.0071	[illegible]	[illegible]	[illegible]	.0035	[illegible]	[illegible]
PHASE ANGLE =	[illegible]	68.4	[illegible]	[illegible]	[illegible]	105.7	[illegible]	[illegible]

TABLE B-6 (Continued)

[illegible] ATION WITH [illegible] ATHENA 10 [illegible]
[illegible] PROPELLER DIA [illegible] 0 FEET [illegible]

[illegible] COMPONENT RATIOS [illegible]

HARMONIC NO.	[illegible]	10	[illegible]	[illegible]	[illegible]	14	15	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	.0157	[illegible]	[illegible]	[illegible]
PHASE ANGLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	.0124	.0124	[illegible]	[illegible]
PHASE ANGLE	[illegible]	41.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0078	[illegible]	[illegible]
PHASE ANGLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	.0032	[illegible]	[illegible]	[illegible]	[illegible]	.0012	[illegible]	[illegible]
PHASE ANGLE	13.7	24.7	[illegible]	[illegible]	[illegible]	28.6	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0029	[illegible]	[illegible]
PHASE ANGLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	155.7	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	.0012	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
PHASE ANGLE	[illegible]	176.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0014	[illegible]	[illegible]
PHASE ANGLE	[illegible]	147.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
RADIUS [illegible]								
AMPLITUDE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.0010	[illegible]	.0005
PHASE ANGLE	[illegible]	117.7	[illegible]	[illegible]	[illegible]	180.0	[illegible]	235.0

APPENDIX C

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 11

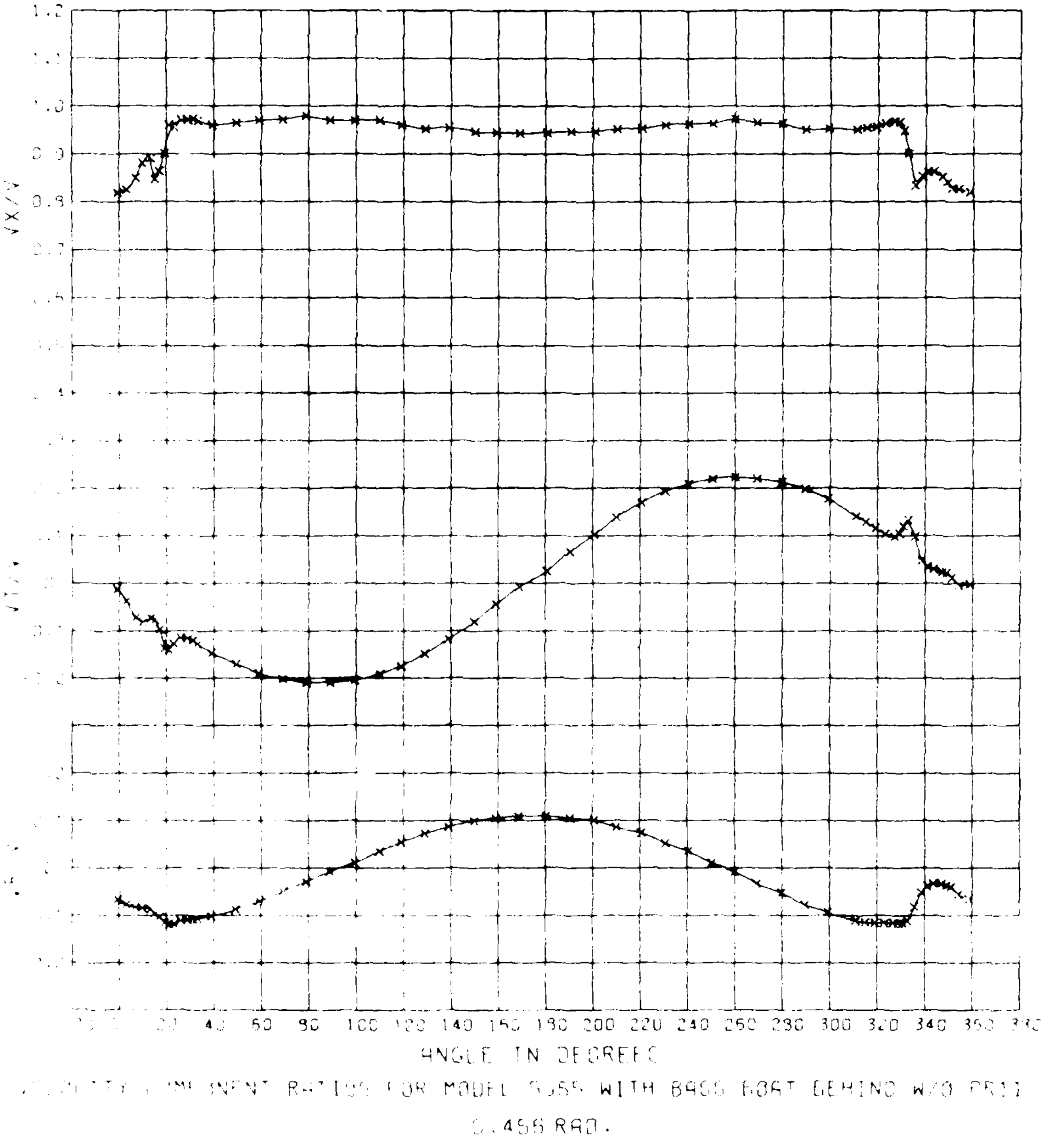


Figure C-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 11

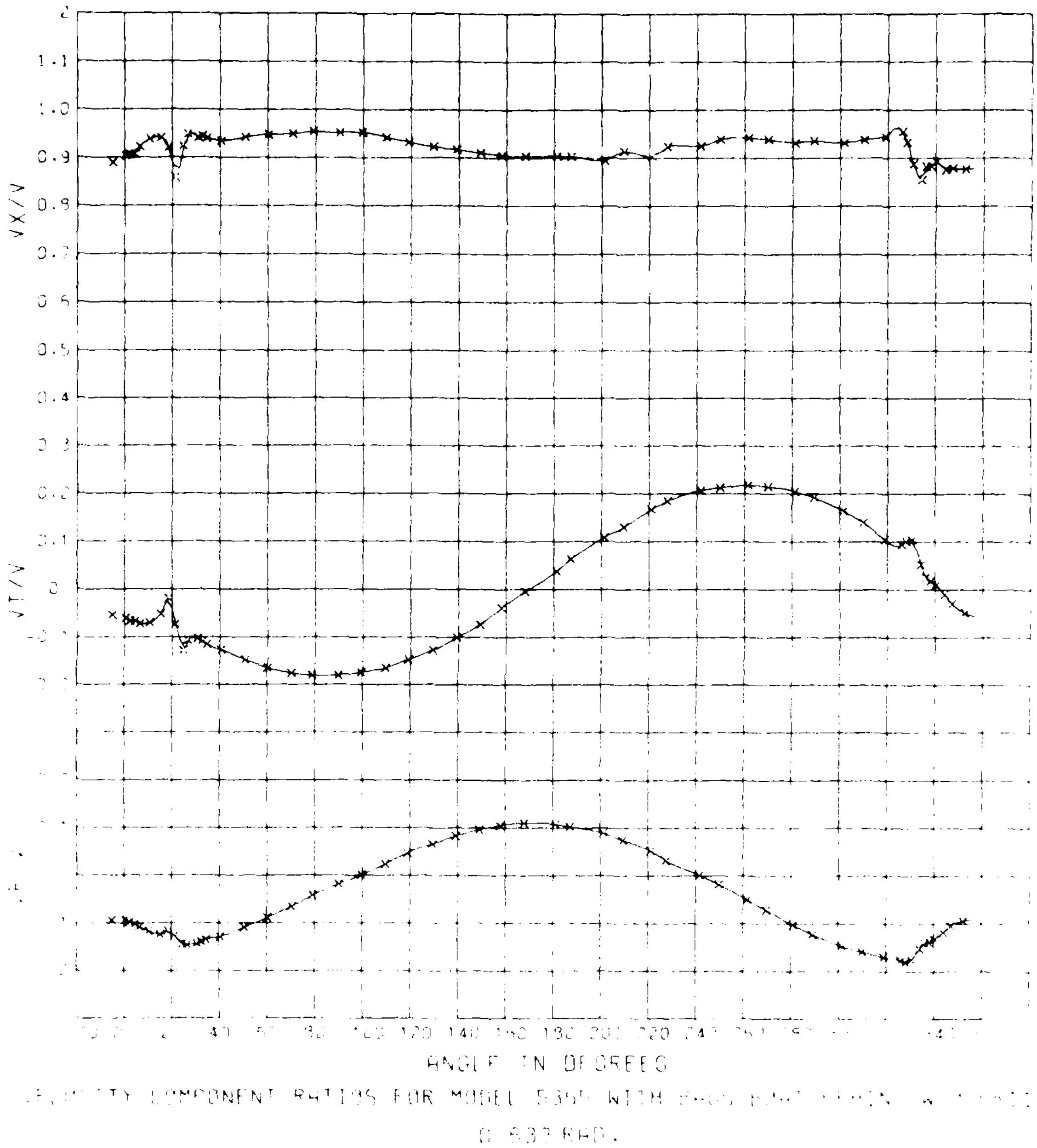


Figure C-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 11

AD-A094 342 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 13/10
ANALYSIS OF WAKE SURVEY EXPERIMENTAL DATA FOR MODEL 5365 REPRES--ETC(U)
JAN 81 R B HURWITZ, L B CROOK

UNCLASSIFIED DTNSRDC/SPD-0833-06 NL

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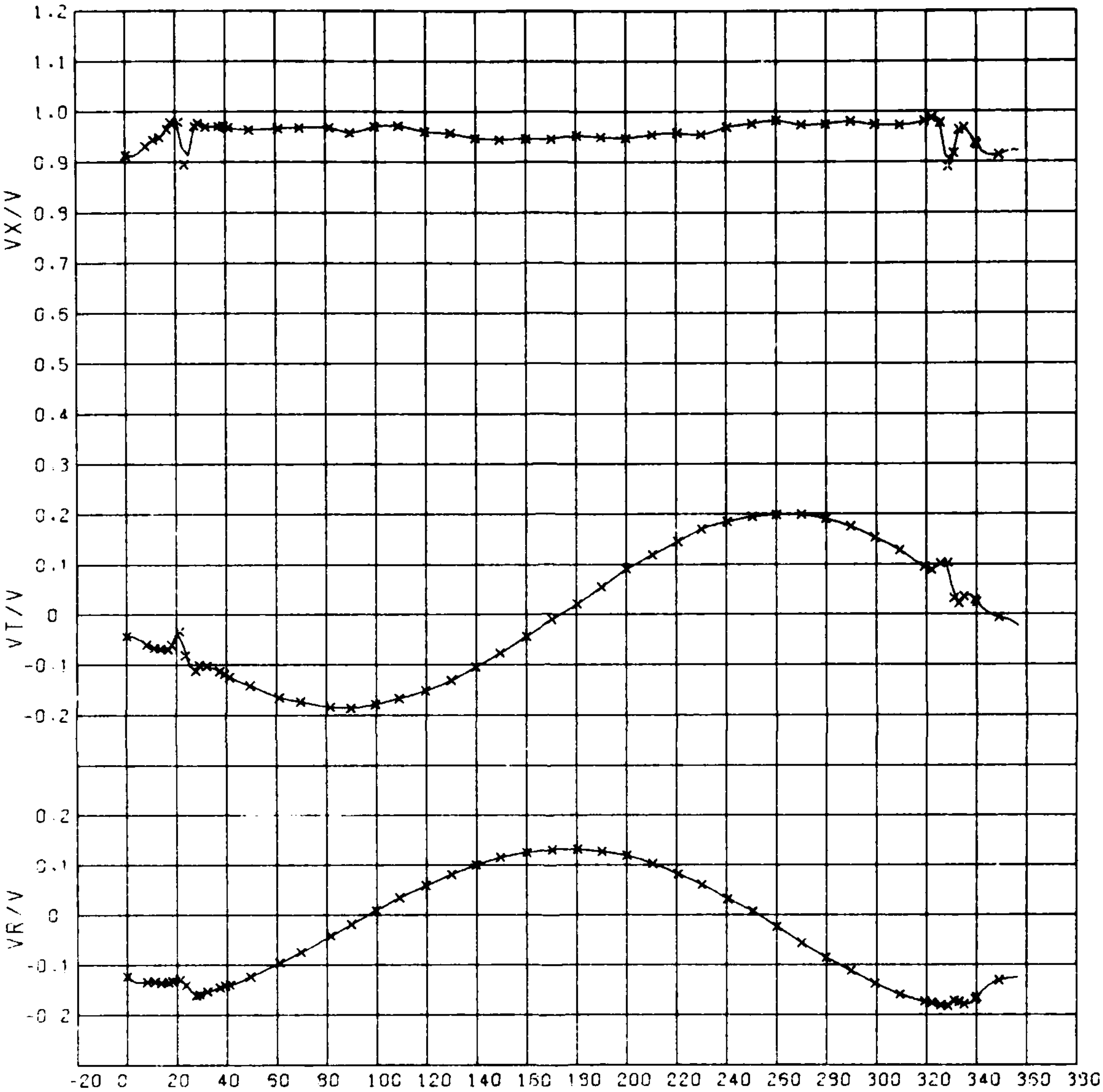

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11

0.781 RAD.

Figure C-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 11

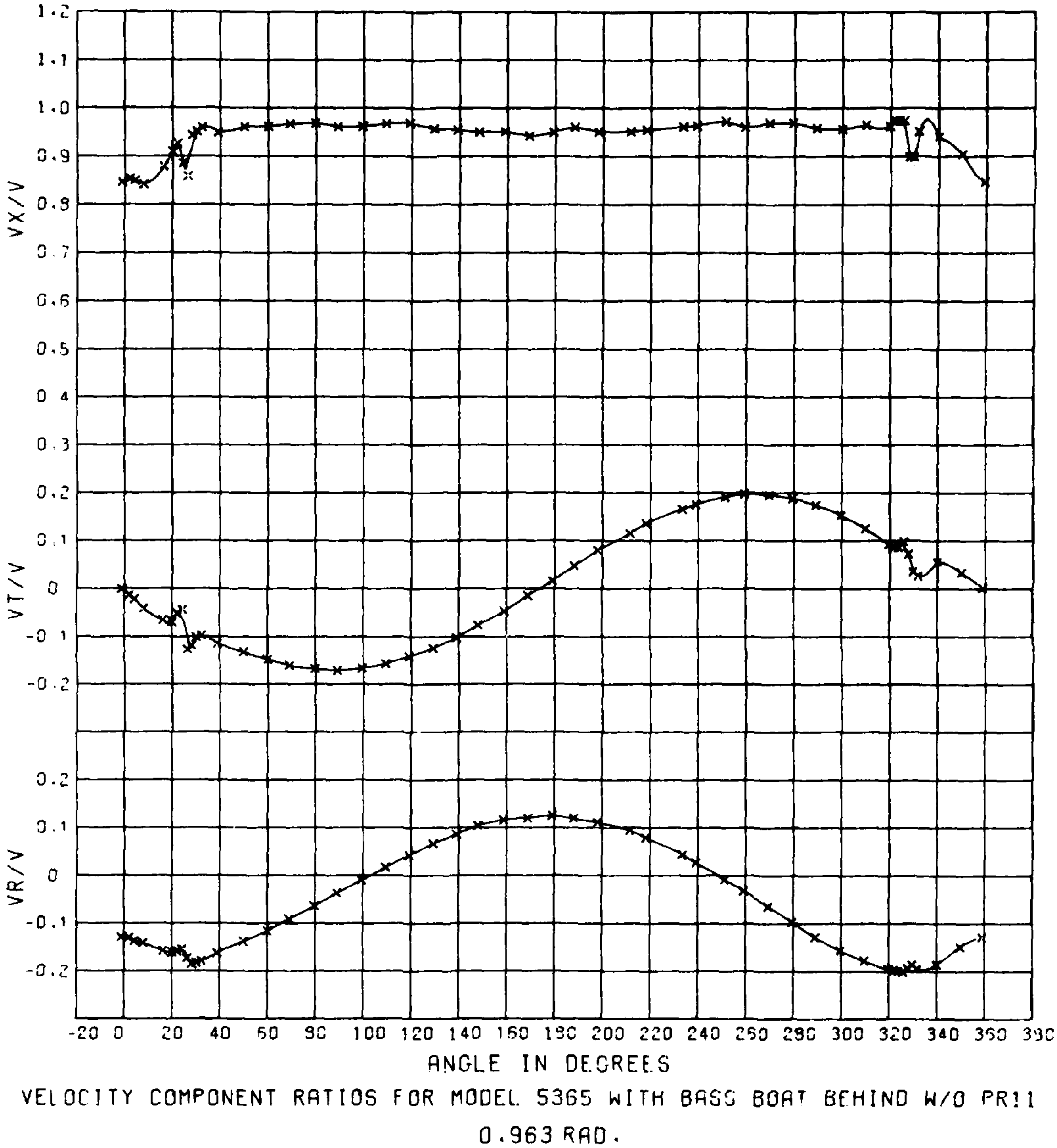

Figure C-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 11

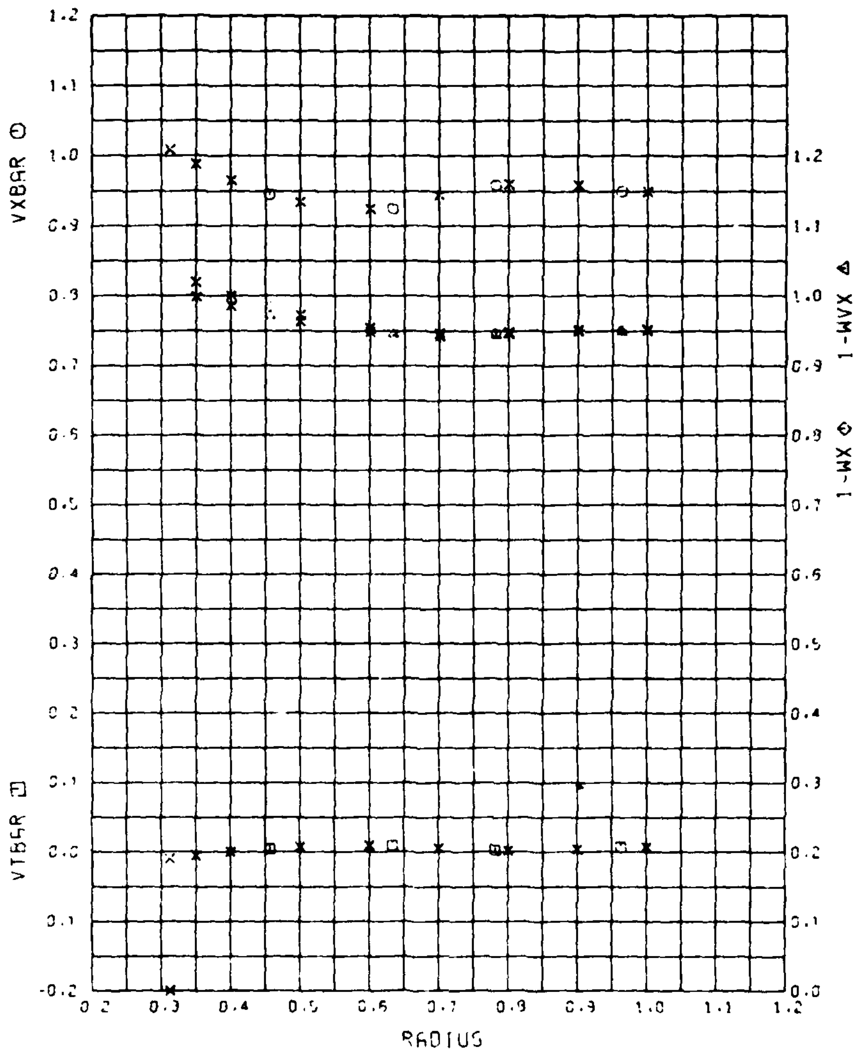

Figure C-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 11

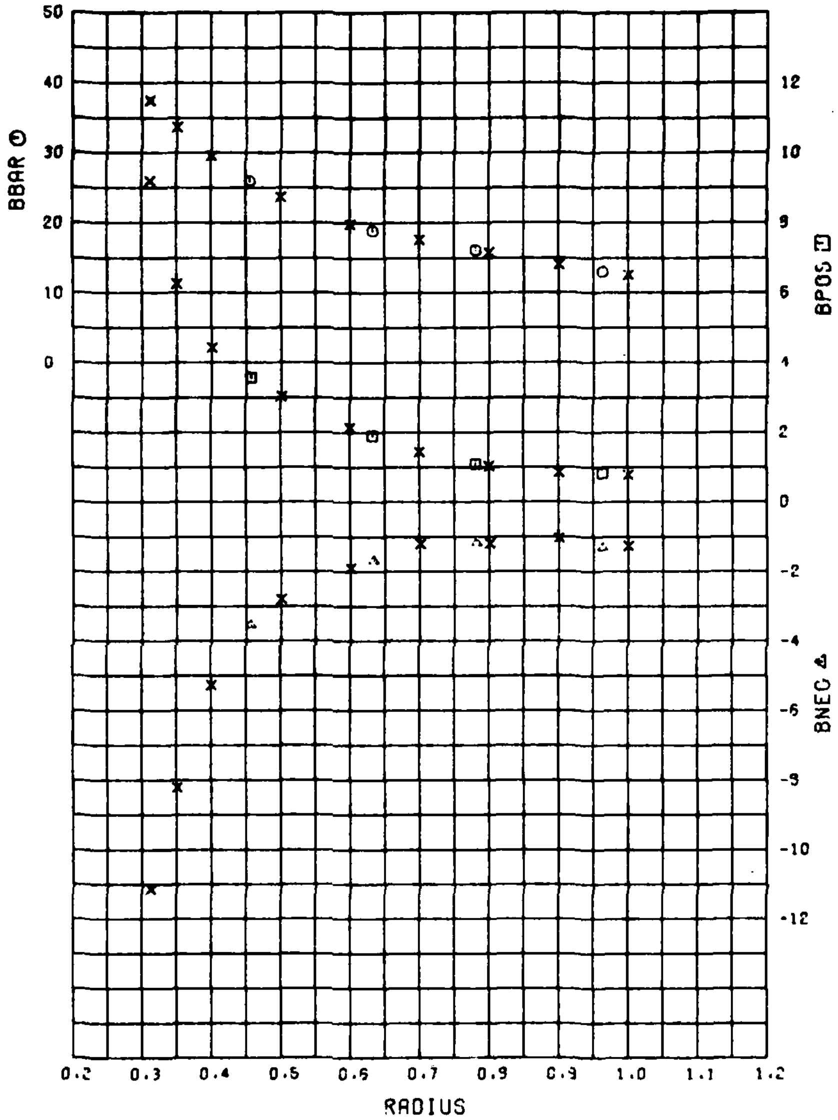

Figure C-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 11

TABLE C-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 11

RADIUS = .496

ANGLE	VX/V	VT/V	VR/V
-.9	.919	-.013	-.060
1.1	.925	-.030	-.077
7.1	.950	-.072	-.086
10.0	.979	-.083	-.087
10.0	.983	-.081	-.086
13.2	.995	-.071	-.086
14.0	.987	-.073	-.090
15.1	.969	-.077	-.096
17.1	.964	-.097	-.103
19.3	.981	-.137	-.116
21.0	.96?	-.140	-.118
23.2	.927	-.133	-.124
23.2	.901	-.122	-.115
26.0	.973	-.114	-.112
29.0	.969	-.117	-.110
29.0	.971	-.118	-.110
31.3	.973	-.122	-.108
33.2	.968	-.120	-.107
39.1	.961	-.147	-.102
49.4	.964	-.170	-.080
59.0	.969	-.190	-.071
69.0	.972	-.202	-.050
79.0	.979	-.209	-.029
89.0	.970	-.210	-.007
99.4	.974	-.205	.011
109.9	.970	-.191	.035
119.0	.960	-.174	.054
129.0	.953	-.149	.073
139.0	.956	-.110	.086
150.0	.967	-.081	.099
159.0	.966	-.044	.10?
160.0	.944	-.000	.109
180.4	.969	.023	.110
190.4	.967	.027	.100
190.5	.967	.067	.105
200.6	.968	.102	.101
210.0	.953	.139	.086
220.5	.954	.170	.074
230.9	.961	.193	.052
240.2	.964	.209	.036
250.3	.964	.219	.018
250.3	.966	.220	.010
259.0	.973	.224	-.008
269.0	.966	.220	-.033
279.6	.963	.213	-.053
299.5	.951	.198	-.078
299.2	.951	.177	-.091
311.0	.957	.142	-.111
315.1	.954	.129	-.114
319.2	.956	.118	-.116
319.2	.959	.115	-.116
323.1	.964	.104	-.116
327.0	.967	.098	-.116
329.1	.967	.105	-.117
330.9	.968	.120	-.117
332.9	.981	.134	-.113
335.0	.969	.114	-.094
336.0	.924	.084	-.071
338.0	.966	.067	-.053
338.9	.942	.067	-.052
341.0	.967	.035	-.039
342.9	.961	.032	-.035
344.0	.966	.027	-.031
347.0	.952	.024	-.033
349.0	.941	.024	-.036
351.0	.929	.012	-.040
354.0	.927	-.006	-.056
358.0	.970	-.010	-.064
359.1	.919	.013	-.060
363.1	.925	-.030	-.077

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-5.0	.989	-.094	-.095
.5	.984	-.061	-.094
2.6	.986	-.066	-.099
4.5	.987	-.067	-.104
6.5	.923	-.072	-.109
10.6	.939	-.070	-.110
14.0	.943	-.062	-.125
16.0	.940	-.043	-.123
18.5	.922	-.020	-.117
20.6	.883	-.032	-.119
22.0	.855	-.113	-.135
24.6	.925	-.129	-.145
26.5	.940	-.103	-.145
26.5	.951	-.112	-.146
30.7	.942	-.103	-.143
32.6	.963	-.108	-.140
32.6	.946	-.110	-.130
34.5	.941	-.116	-.135
40.5	.935	-.120	-.129
50.5	.943	-.140	-.109
60.2	.940	-.165	-.089
70.4	.950	-.176	-.066
79.0	.955	-.180	-.042
90.0	.952	-.181	-.019
99.6	.954	-.175	.001
109.6	.943	-.165	.024
119.0	.933	-.140	.047
129.3	.924	-.120	.067
139.2	.918	-.101	.083
149.1	.912	-.073	.097
150.0	.906	-.030	.105
160.0	.903	-.004	.110
181.1	.904	.030	.108
187.1	.906	.064	.103
201.2	.895	.109	.090
209.3	.915	.130	.075
221.0	.904	.160	.052
227.4	.925	.186	.032
241.4	.925	.207	.002
249.7	.939	.212	-.019
261.5	.943	.218	-.050
269.0	.939	.215	-.072
281.0	.933	.205	-.103
289.0	.936	.192	-.123
289.0	.937	.192	-.121
301.4	.932	.164	-.146
309.9	.939	.140	-.159
319.0	.944	.104	-.169
326.1	.955	.093	-.176
327.9	.933	.101	-.180
329.9	.911	.117	-.181
331.0	.864	.095	-.171
333.9	.852	.095	-.153
334.2	.859	.069	-.152
335.9	.883	.025	-.140
338.0	.882	.010	-.136
340.0	.895	.011	-.133
340.3	.891	.009	-.131
344.0	.876	-.010	-.118
347.0	.879	-.030	-.105
352.3	.876	-.049	-.094
355.0	.989	-.094	-.095
360.5	.984	-.061	-.094

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
0.0	.913	-.043	-.123
0.0	.931	-.060	-.136
11.0	.943	-.067	-.133
13.0	.940	-.068	-.135
14.0	.950	-.069	-.137
16.0	.966	-.070	-.136
17.1	.963	-.069	-.136
18.0	.970	-.060	-.133
21.1	.979	-.033	.129
22.9	.897	-.037	-.128
24.0	.893	-.127	-.154
27.0	.960	-.122	-.162
28.0	.975	-.103	-.161
29.0	.977	-.101	-.160
32.0	.970	-.103	-.153
37.1	.970	-.113	-.145
39.1	.971	-.119	-.141
41.1	.960	-.125	-.140
49.3	.964	-.142	-.123
61.0	.967	-.165	-.096
69.6	.960	-.173	-.074
81.4	.969	-.184	-.042
89.7	.958	-.186	-.019
99.5	.972	-.179	.009
109.0	.972	-.167	.035
119.6	.963	-.152	.059
129.0	.958	-.132	.081
139.7	.947	-.105	.100
149.0	.967	-.077	.115
149.9	.942	-.077	.115
160.0	.946	-.044	.124
170.1	.941	-.010	.132
178.1	.949	-.011	.130
180.2	.951	.021	.131
188.3	.955	.022	.132
190.0	.949	.055	.127
200.0	.947	.090	.119
210.4	.954	.119	.102
220.5	.958	.145	.082
230.0	.954	.170	.061
240.3	.969	.184	.033
250.3	.976	.194	.007
259.9	.982	.190	-.024
269.9	.973	.199	-.056
279.6	.975	.190	-.086
289.6	.980	.175	-.112
299.3	.973	.153	-.137
309.2	.977	.120	-.159
319.1	.981	.095	-.174
322.0	.997	.080	-.177
325.0	.983	.093	-.180
326.0	.972	.111	-.182
328.0	.893	.102	-.181
328.9	.888	.104	-.184
330.9	.916	.032	-.172
332.9	.963	.023	-.175
334.9	.960	.036	-.179
338.9	.944	.035	-.170
340.0	.931	.024	-.167
348.0	.933	.025	-.164
348.9	.914	-.006	-.131
360.0	.913	-.043	-.123

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-1.0	.847	-.001	-.129
2.2	.894	-.016	-.130
4.3	.898	-.022	-.137
8.1	.862	-.041	-.141
16.4	.879	-.066	-.158
20.2	.910	-.070	-.161
22.2	.927	-.093	-.159
24.4	.881	-.066	-.151
24.4	.891	-.062	-.156
26.4	.859	-.127	-.173
28.2	.944	-.119	-.104
28.3	.944	-.119	-.104
30.0	.954	-.108	-.102
30.4	.949	-.102	-.103
32.4	.960	-.090	-.179
39.0	.958	-.115	-.162
50.0	.961	-.133	-.130
60.0	.962	-.140	-.116
69.0	.967	-.160	-.091
79.7	.969	-.167	-.065
89.0	.962	-.171	-.037
99.4	.963	-.167	-.010
109.3	.968	-.157	.017
119.2	.970	-.142	.042
129.2	.958	-.124	.067
139.0	.956	-.102	.087
140.0	.951	-.076	.104
150.0	.952	-.040	.116
160.9	.943	-.015	.120
179.0	.950	.016	.125
180.0	.961	.047	.120
190.0	.952	.080	.111
211.3	.952	.115	.094
210.0	.955	.136	.079
233.1	.962	.166	.044
239.0	.964	.176	.027
251.2	.972	.191	-.009
259.0	.961	.197	-.033
269.4	.969	.195	-.065
279.3	.970	.180	-.097
289.0	.959	.174	-.129
299.5	.956	.153	-.157
309.6	.965	.125	-.170
319.6	.963	.093	-.195
321.9	.974	.087	-.197
323.7	.975	.086	-.199
325.7	.974	.090	-.202
327.7	.891	.029	-.187
327.0	.987	.116	-.200
329.6	.980	.030	-.186
329.7	.897	.033	-.186
331.7	.952	.026	-.194
339.9	.961	.055	-.165
349.9	.989	.033	-.149
359.0	.847	.001	-.129
362.2	.854	-.014	-.130

TABLE C-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 11

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.945	.925	.958	.949	1.009	.998	.965	.934	.924	.945	.960	.958	.949
VTBAR =	.004	.009	.003	.007	-.010	-.005	-.000	.007	.009	.005	.002	.004	.007
VRBAR =	-.007	-.033	-.026	-.040	.040	.025	.008	-.017	-.031	-.028	-.027	-.033	-.040
1-WVX =	.971	.945	.943	.948	0.000	.998	.985	.963	.948	.943	.946	.949	.950
1-WX =	.984	.950	.946	.950	0.000	1.019	1.001	.972	.954	.947	.948	.951	.952
BBAR =	25.93	18.90	16.08	13.02	37.46	33.67	29.56	23.64	19.84	17.58	15.74	14.04	12.56
BPOS =	3.56	1.91	1.09	.83	9.18	6.25	4.43	3.01	2.14	1.44	1.03	.85	.78
THETA =	80.00	80.00	102.50	77.50	20.00	20.00	80.00	80.00	80.00	80.00	102.50	77.50	77.50
BNEG =	-3.53	-1.67	-1.18	-1.31	-11.09	-8.15	-5.19	-2.80	-1.89	-1.21	-1.20	-1.04	-1.27
THETA =	335.00	332.50	327.50	357.50	0.00	0.00	0.00	335.00	332.50	330.00	327.50	327.50	357.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE C-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 11

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0233	.0347	.0195	.0167	.0152	.0116	.0063	.0018
PHASE ANGLE =	283.6	283.5	282.2	283.3	288.8	298.0	305.6	308.8
RADIUS = .633								
AMPLITUDE =	.0083	.0237	.0054	.0044	.0080	.0060	.0052	.0046
PHASE ANGLE =	37.0	278.5	297.3	312.8	324.3	355.9	27.4	50.9
RADIUS = .781								
AMPLITUDE =	.0036	.0178	.0075	.0061	.0069	.0031	.0024	.0013
PHASE ANGLE =	196.3	276.8	294.9	311.8	290.3	339.8	347.7	272.1
RADIUS = .963								
AMPLITUDE =	.0184	.0255	.0148	.0130	.0125	.0065	.0066	.0042
PHASE ANGLE =	263.7	263.7	248.8	245.5	237.9	237.2	235.2	235.1

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0020	.0035	.0032	.0041	.0027	.0007	.0023	.0041
PHASE ANGLE =	156.6	128.6	136.1	159.1	156.7	235.5	274.0	305.2
RADIUS = .633								
AMPLITUDE =	.0028	.0034	.0013	.0006	.0034	.0035	.0046	.0053
PHASE ANGLE =	58.3	88.3	99.7	207.8	290.5	322.8	298.2	318.0
RADIUS = .781								
AMPLITUDE =	.0007	.0019	.0013	.0026	.0024	.0018	.0009	.0012
PHASE ANGLE =	299.5	91.4	263.7	283.8	261.8	332.6	313.0	175.5
RADIUS = .963								
AMPLITUDE =	.0041	.0015	.0031	.0026	.0009	.0019	.0012	.0013
PHASE ANGLE =	190.2	241.9	257.2	329.6	351.8	335.0	337.4	27.3

TABLE C-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 11

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0732	.0472	.0446	[illegible]	.0317	.0267	.0202	.0148
PHASE ANGLE =	265.3	287.5	279.6	279.3	266.9	273.2	269.8	252.2
RADIUS = .350								
AMPLITUDE =	.0573	.0436	.0368	.0322	.0263	.0217	.0155	.0104
PHASE ANGLE =	267.9	286.5	230.0	279.9	271.1	277.5	274.4	255.0
RADIUS = .400								
AMPLITUDE =	.0393	.0392	.0278	.0242	.0203	.0163	.0104	.0055
PHASE ANGLE =	273.1	285.1	230.8	261.0	278.1	285.2	284.2	263.4
RADIUS = .500								
AMPLITUDE =	.0141	.0316	.0143	.0130	.0123	.0090	.0048	.0023
PHASE ANGLE =	300.1	282.2	284.1	286.5	299.0	311.9	333.5	24.1
RADIUS = .600								
AMPLITUDE =	.0079	.0254	.0066	.0053	.0087	.0064	.0051	.0047
PHASE ANGLE =	19.9	279.3	293.1	303.7	320.7	347.6	21.8	49.7
RADIUS = .700								
AMPLITUDE =	.0033	.0198	[illegible]	.0055	.0073	.0049	.0041	.0018
PHASE ANGLE =	75.5	279.2	304.5	323.3	313.2	355.3	17.1	34.7
RADIUS = .800								
AMPLITUDE =	.0046	.0178	.0078	.0062	.0070	.0027	.0021	.0017
PHASE ANGLE =	209.9	275.7	290.7	305.9	283.7	330.5	333.1	261.1
RADIUS = .900								
AMPLITUDE =	.0118	.0209	[illegible]	[illegible]	.0094	.0036	.0038	.0036
PHASE ANGLE =	249.0	[illegible]	[illegible]	[illegible]	251.4	254.4	250.8	241.9
RADIUS = 1.000								
AMPLITUDE =	.0184	.0255	.0148	.0130	.0125	.0065	.0066	.0042
PHASE ANGLE =	263.7	263.7	248.8	245.5	237.9	237.2	235.2	235.1

TABLE C-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0094	.0060	.0058	.0083	.0131	.0074	.0059	.0052
PHASE ANGLE =	209.5	179.6	166.5	165.2	138.8	154.5	140.7	173.7
RADIUS = .350								
AMPLITUDE =	.0068	.0049	.0049	.0072	.0098	.0051	.0035	.0028
PHASE ANGLE =	204.7	169.1	159.5	163.5	140.2	157.2	150.3	196.2
RADIUS = .400								
AMPLITUDE =	.0040	.0040	.0040	.0053	.0061	.0025	.0014	.0022
PHASE ANGLE =	192.7	151.1	149.0	161.3	143.8	165.6	198.3	271.9
RADIUS = .500								
AMPLITUDE =	.0018	.0035	.0027	.0030	.0011	.0015	.0035	.0052
PHASE ANGLE =	107.3	113.2	125.9	158.1	206.6	304.4	287.5	312.5
RADIUS = .600								
AMPLITUDE =	.0028	.0035	.0017	.0010	.0030	.0033	.0047	.0058
PHASE ANGLE =	63.7	91.9	105.3	172.6	288.9	321.0	296.7	317.8
RADIUS = .700								
AMPLITUDE =	.0014	.0028	.0001	.0016	.0030	.0025	.0025	.0018
PHASE ANGLE =	30.0	89.3	176.3	269.1	274.0	326.6	300.1	298.9
RADIUS = .800								
AMPLITUDE =	.0008	.0015	.0015	.0027	.0023	.0017	.0007	.0014
PHASE ANGLE =	272.5	93.3	263.8	286.6	260.5	334.0	321.1	155.7
RADIUS = .900								
AMPLITUDE =	.0024	.0004	.0026	.0028	.0011	.0016	.0007	.0012
PHASE ANGLE =	207.5	194.4	266.1	306.5	275.0	337.3	355.8	128.3
RADIUS = 1.000								
AMPLITUDE =	.0041	.0015	.0031	.0026	.0009	.0019	.0012	.0013
PHASE ANGLE =	190.2	241.9	257.2	329.6	351.8	335.0	337.4	27.3

TABLE C-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 11

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2175	.0025	.0019	.0018	.0022	.0041	.0012	.0008
PHASE ANGLE =	187.3	305.7	205.8	204.7	186.1	205.1	207.7	214.4
RADIUS = .633								
AMPLITUDE =	.1986	.0140	.0080	[illegible]	.0062	.0044	.0049	.0045
PHASE ANGLE =	190.1	306.5	306.5	307.0	314.3	313.2	317.4	331.0
RADIUS = .781								
AMPLITUDE =	.1884	.0100	.0054	.0034	.0021	.0016	.0015	.0014
PHASE ANGLE =	187.5	322.6	332.0	314.2	315.0	298.9	326.2	323.2
RADIUS = .963								
AMPLITUDE =	.1799	.0077	.0033	.0029	.0036	.0031	.0029	.0025
PHASE ANGLE =	185.7	325.9	25.0	87.7	119.5	123.6	135.3	157.1

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0019	.0023	.0032	.0025	.0027	.0015	.0017	.0018
PHASE ANGLE =	46.2	47.7	63.1	63.2	84.5	100.0	147.5	199.2
RADIUS = .633								
AMPLITUDE =	.0030	.0034	.0013	.0005	.0016	.0024	.0031	.0028
PHASE ANGLE =	339.4	331.7	15.6	279.1	168.0	193.6	186.5	199.4
RADIUS = .781								
AMPLITUDE =	.0004	.0004	.0006	.0021	.0020	.0022	.0017	.0008
PHASE ANGLE =	124.2	181.7	150.4	190.1	191.4	192.0	201.7	196.5
RADIUS = .963								
AMPLITUDE =	.0025	.0018	.0024	.0023	.0016	.0016	.0009	.0008
PHASE ANGLE =	175.3	194.1	202.7	221.8	236.2	252.5	313.0	336.9

LE C-6 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 11

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2401	.0205	.0170	.0194	.0180	.0160	.0125	.0116
PHASE ANGLE =	181.5	119.4	135.2	164.9	149.0	171.7	150.4	161.7
RADIUS = .350								
AMPLITUDE =	.2335	.0132	.0119	.0146	.0129	.0127	.0098	.0080
PHASE ANGLE =	183.2	119.4	138.[illegible]	163.0	151.0	175.1	152.8	163.3
RADIUS = .400								
AMPLITUDE =	.2254	.0050	.0061	.0092	.0071	.0080	.0045	.0041
PHASE ANGLE =	185.3	118.5	147.[illegible]	178.[illegible]	156.7	183.1	159.8	163.2
RADIUS = .500								
AMPLITUDE =	.2120	.0071	.0033	.0035	.0021	.0027	.0020	.0018
PHASE ANGLE =	188.5	303.6	279.8	247.4	281.0	246.7	294.4	316.0
RADIUS = .600								
AMPLITUDE =	.2015	.0133	.0074	.0057	.0058	.0041	.0047	.0043
PHASE ANGLE =	190.1	305.3	303.2	301.6	312.4	308.2	315.7	330.2
RADIUS = .700								
AMPLITUDE =	.1936	.0119	.0067	.0051	.0044	.0032	.0034	.0031
PHASE ANGLE =	188.9	314.2	317.1	308.3	313.4	307.8	319.8	329.2
RADIUS = .800								
AMPLITUDE =	.1873	.0097	.0051	.0030	.0016	.0012	.0011	.0010
PHASE ANGLE =	187.3	324.2	336.0	317.2	317.1	294.9	330.2	319.1
RADIUS = .900								
AMPLITUDE =	.1824	.0083	.0038	.0012	.0016	.0013	.0013	.0012
PHASE ANGLE =	186.1	328.3	1.9	36.[illegible]	115.2	132.0	128.9	163.6
RADIUS = 1.000								
AMPLITUDE =	.1799	.0077	.0033	.0029	.0036	.0031	.0029	.0025
PHASE ANGLE =	185.7	325.9	25.0	87.7	119.5	123.6	135.3	157.1

TABLE C-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND W/O PR11
PROPELLER DIAMETER = 6.00 FEET JA = [illegible]

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0077	.0095	[illegible]	.0069	.0065	.0060	.0038	.0017
PHASE ANGLE =	121.8	114.8	68.7	83.4	65.0	56.7	46.6	21.4
RADIUS = .350								
AMPLITUDE =	.0054	.0068	.0057	.0055	.0054	.0045	.0026	.0005
PHASE ANGLE =	115.1	108.3	83.[illegible]	79.7	68.0	60.9	59.7	23.7
RADIUS = .400								
AMPLITUDE =	.0030	.0040	.0043	.0040	.0040	.0028	.0016	.0007
PHASE ANGLE =	96.6	91.8	75.3	73.4	73.7	71.2	90.6	1[illegible]7.8
RADIUS = .500								
AMPLITUDE =	.0022	.0025	.0025	.0016	.0020	.0013	.0023	.0024
PHASE ANGLE =	8.8	8.3	51.4	50.8	99.0	142.8	166.8	199.5
RADIUS = .600								
AMPLITUDE =	.0031	.0035	.0015	.0005	.0015	.0022	.0031	.0029
PHASE ANGLE =	342.3	335.9	23.2	328.7	153.6	189.5	183.5	199.5
RADIUS = .700								
AMPLITUDE =	.0013	.0014	.0006	.0012	.0019	.0025	.0025	.0018
PHASE ANGLE =	348.9	330.7	40.[illegible]	195.8	179.9	169.7	191.6	1[illegible]7.0
RADIUS = .800								
AMPLITUDE =	.0007	.0007	[illegible]	[illegible]	.0020	.0021	.0015	.0006
PHASE ANGLE =	142.3	174.6	162.7	[illegible]	194.2	193.8	205.4	1[illegible]8.1
RADIUS = .900								
AMPLITUDE =	.0020	.0017	.0017	[illegible]	.0018	.0016	.0007	.0004
PHASE ANGLE =	165.8	[illegible].9	192.2	20[illegible]	2[illegible]4.3	218.5	256.[illegible]	3[illegible].4
RADIUS = 1.000								
AMPLITUDE =	.0025	.0018	.0024	.0023	.0016	.0016	.0009	.0008
PHASE ANGLE =	175.3	194.1	202.7	221.8	230.2	252.5	313.0	306.9

APPENDIX D

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 12

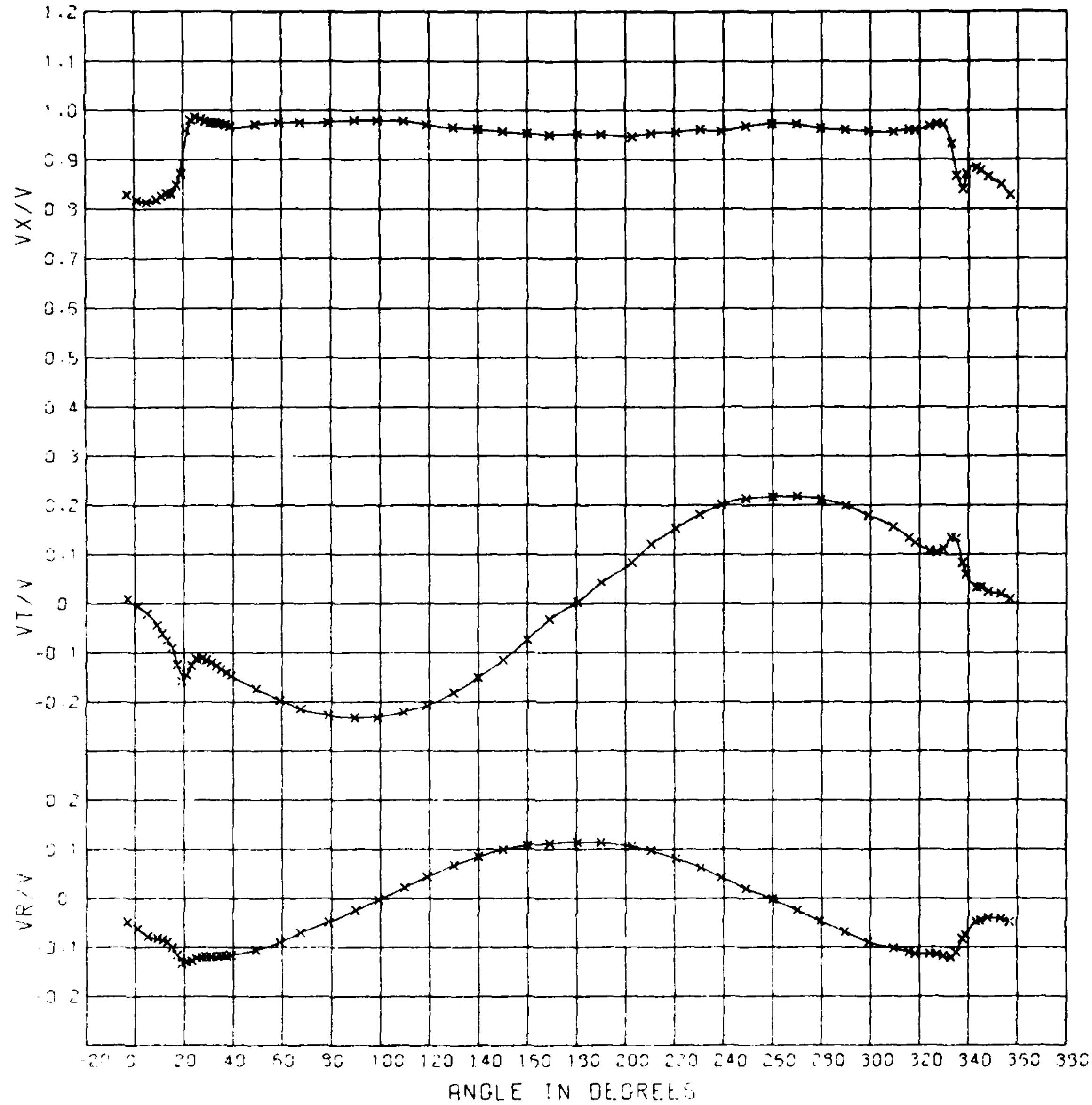

Figure D-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 12

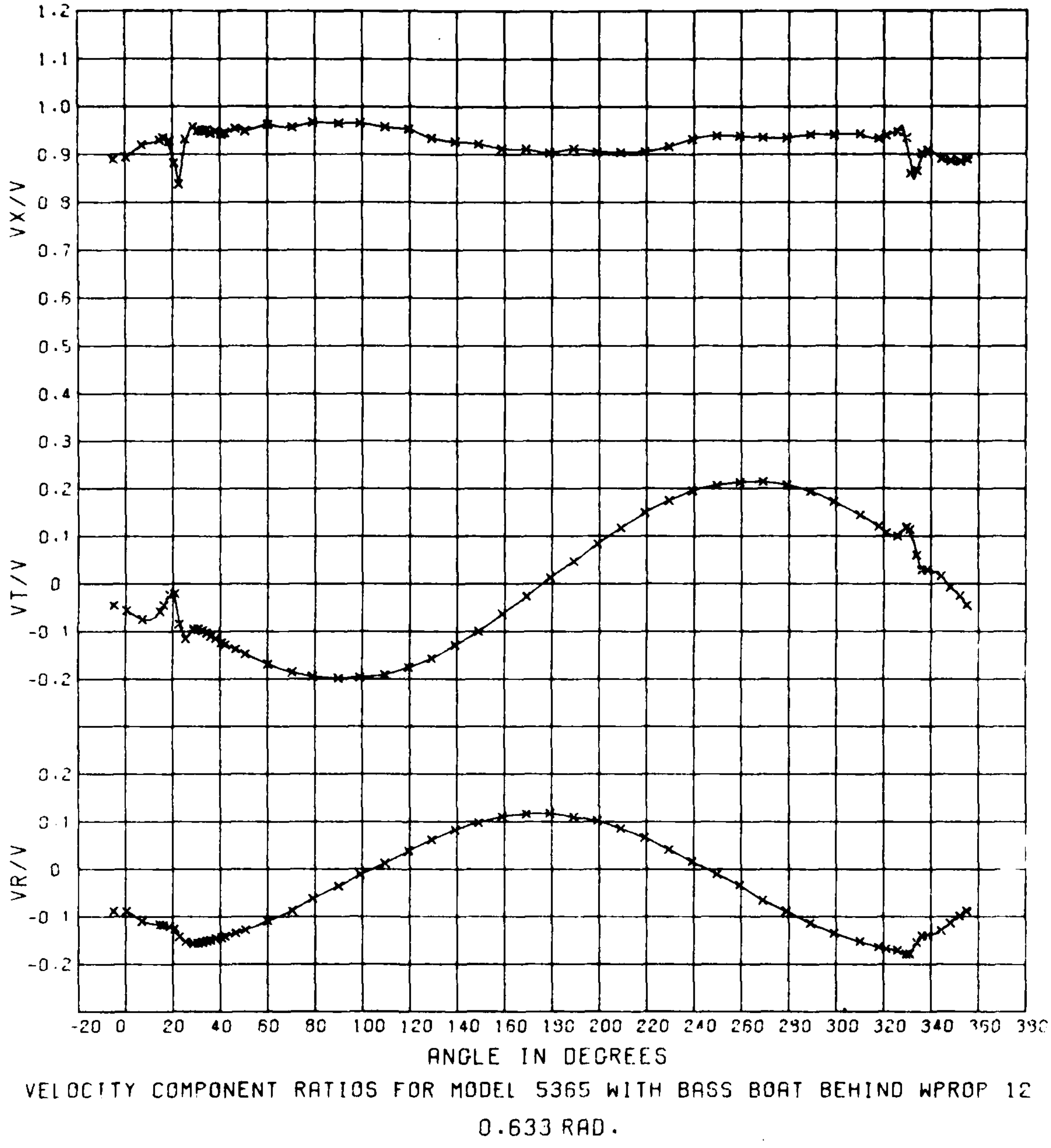

Figure D-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 12

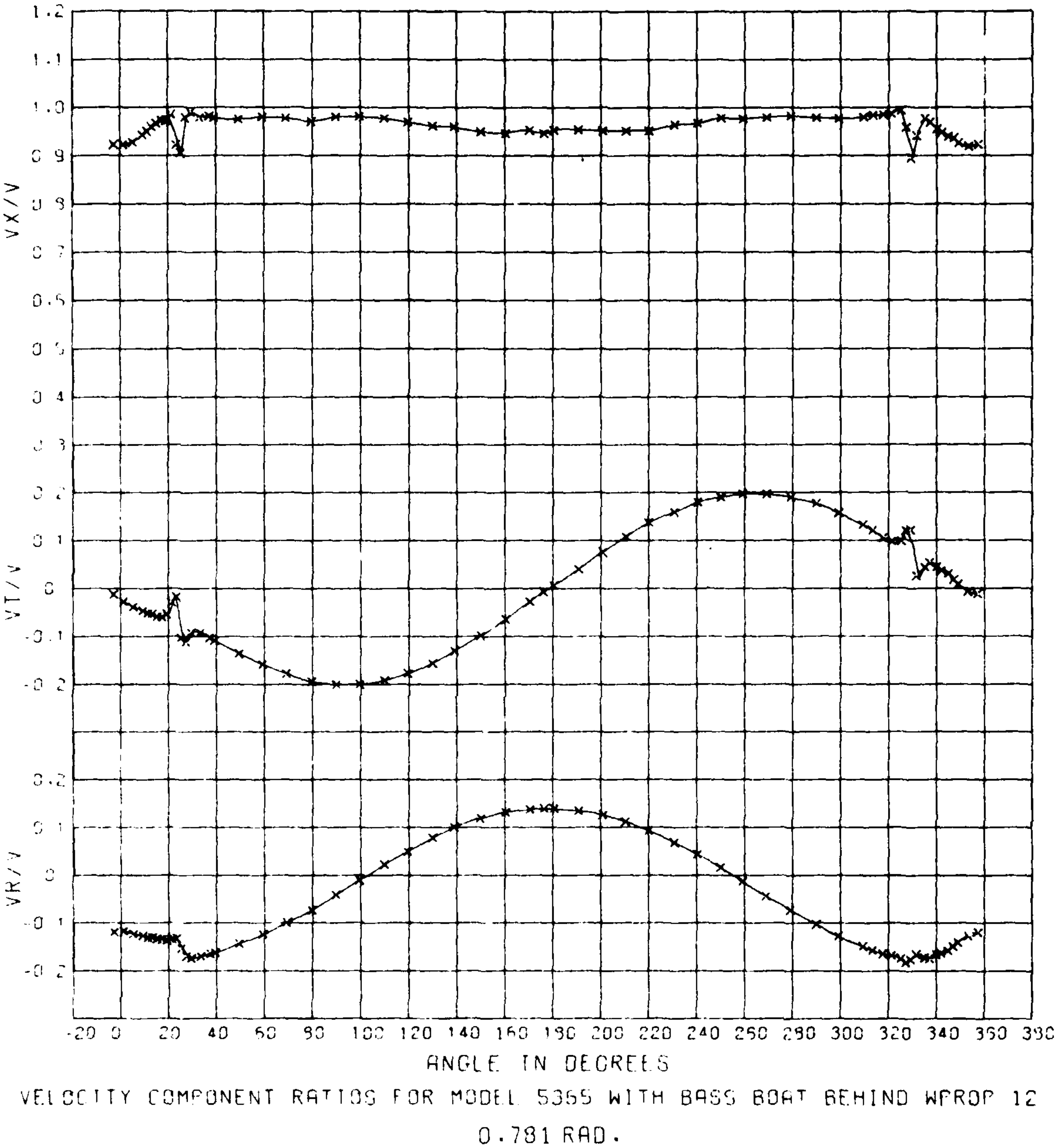

Figure D-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 12

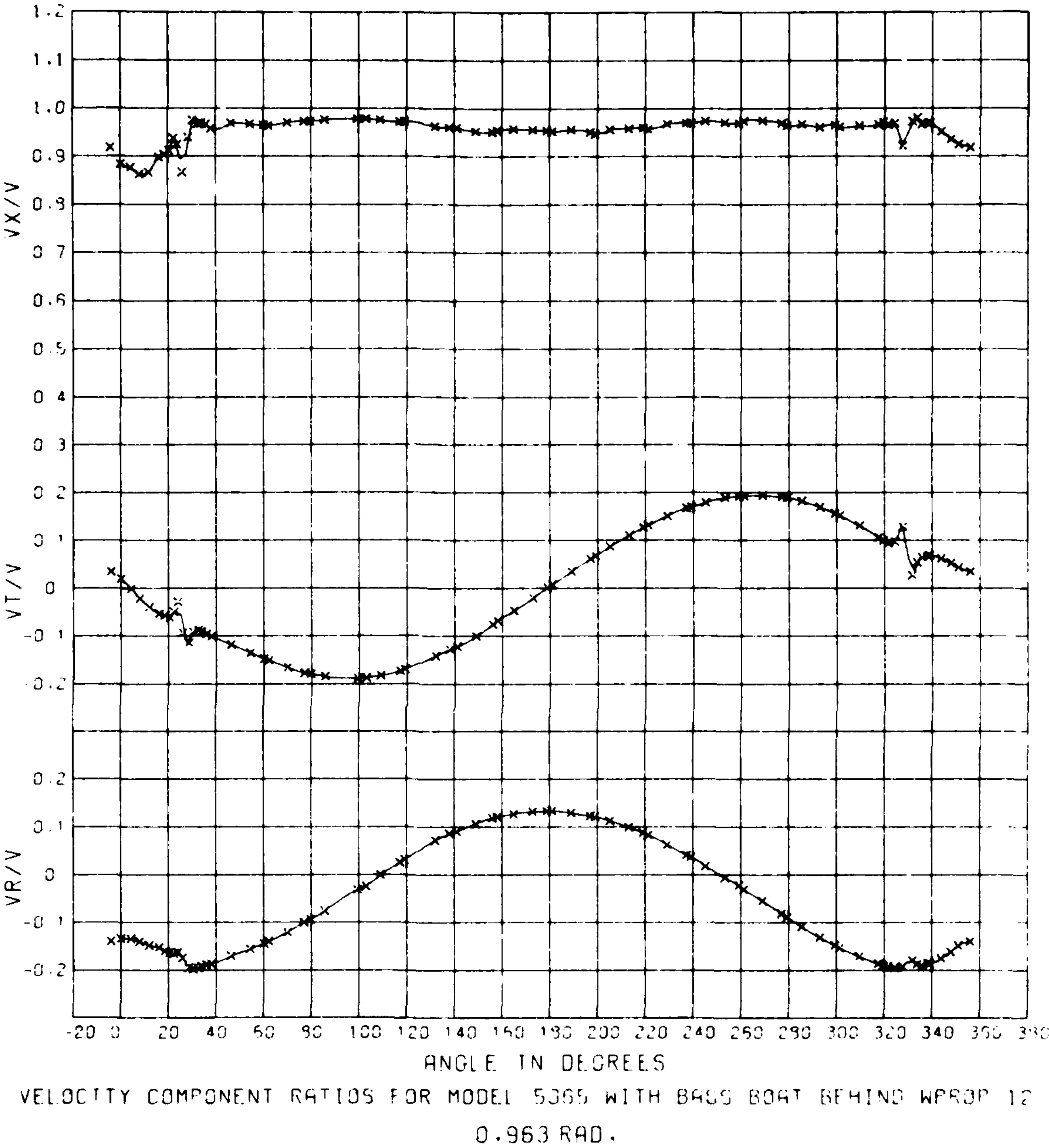

Figure D-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 12

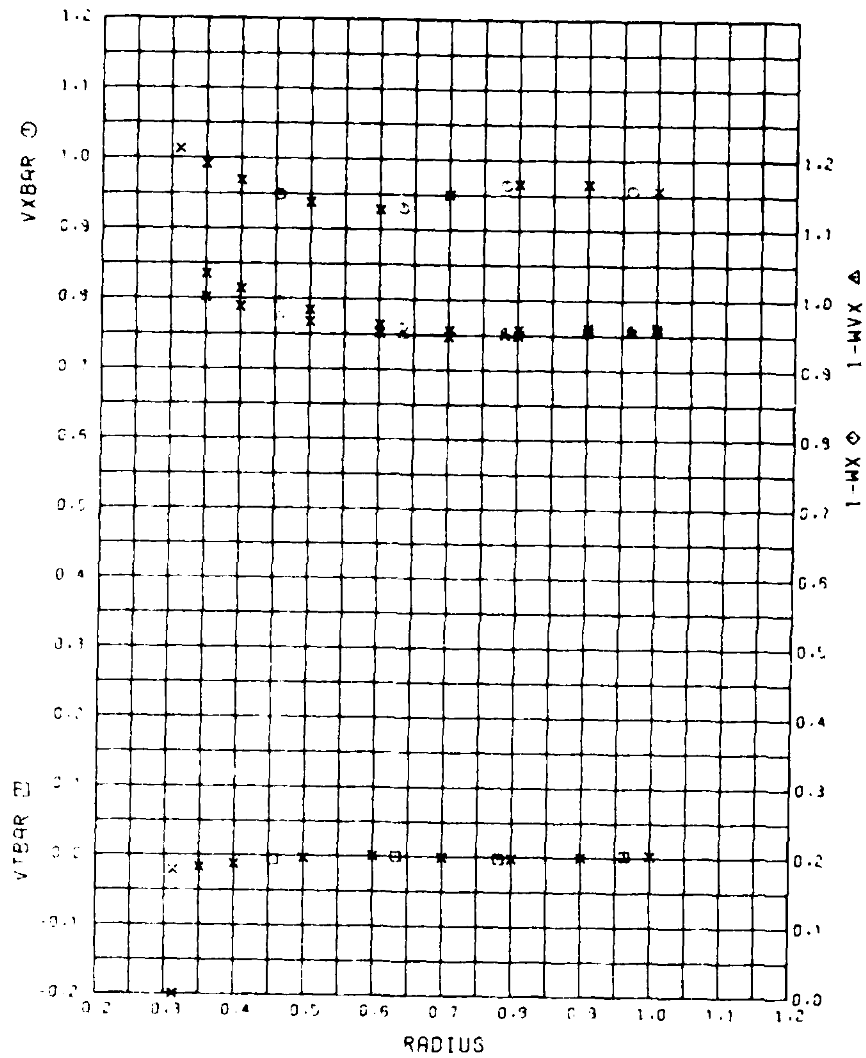

Figure D-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 12

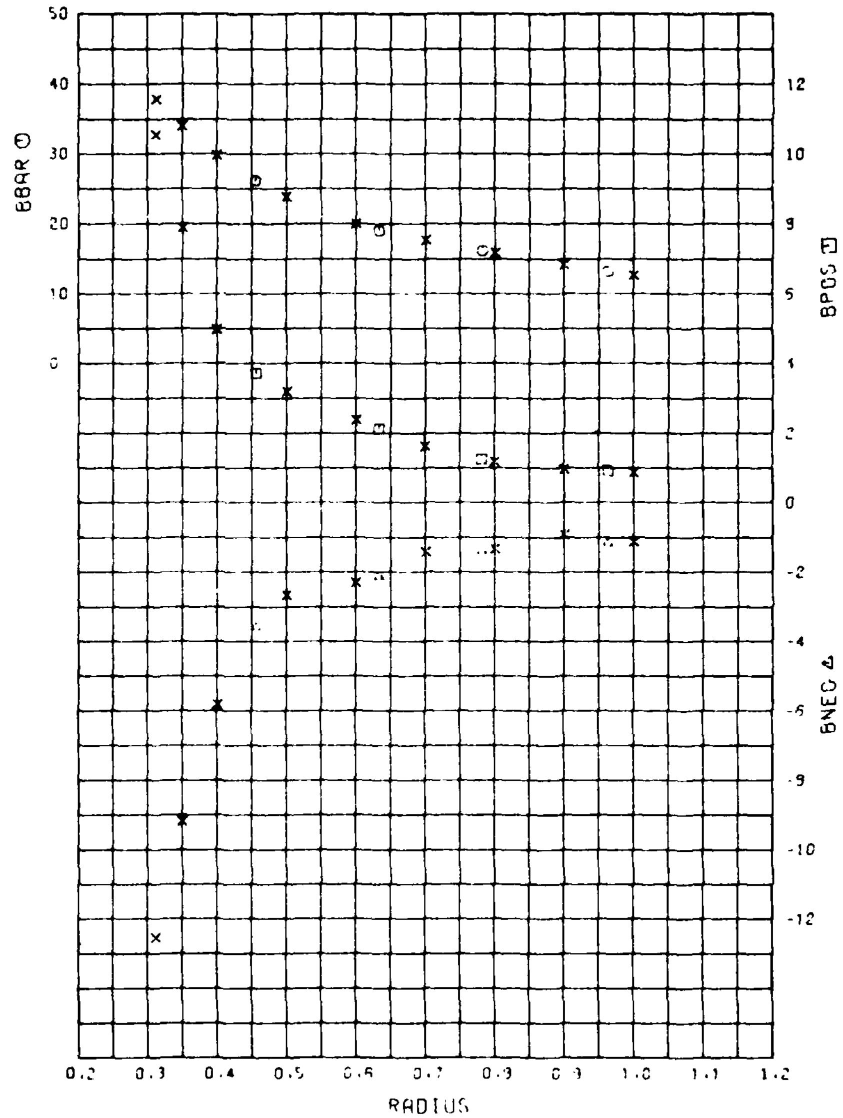

Figure D-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 12

TABLE D-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA, MODEL 5365, EXPERIMENT 12

RADIUS = .656

ANGLE	VX/V	VT/V	VR/V
-3.0	.829	.009	-.049
1.1	.819	-.005	-.063
5.1	.816	-.021	-.070
9.2	.819	-.044	-.082
11.2	.826	-.062	-.085
13.2	.833	-.075	-.089
15.1	.831	-.098	-.100
17.2	.869	-.124	-.116
19.0	.877	-.157	-.133
21.0	.963	-.166	-.131
23.2	.982	-.126	-.120
25.0	.980	-.112	-.123
27.3	.983	-.112	-.120
29.0	.977	-.116	-.128
31.2	.979	-.120	-.119
33.3	.976	-.127	-.119
35.2	.973	-.133	-.119
37.3	.971	-.141	-.116
39.0	.966	-.147	-.116
39.2	.968	-.147	-.117
49.6	.970	-.173	-.106
59.0	.979	-.197	-.090
67.9	.976	-.215	-.070
79.0	.979	-.227	-.049
89.7	.979	-.232	-.026
99.0	.979	-.231	-.003
109.7	.978	-.221	.022
119.0	.978	-.208	.044
129.0	.984	-.181	.064
139.9	.967	-.151	.085
150.0	.997	-.115	.099
159.9	.951	-.076	.108
169.0	.955	-.032	.112
180.6	.958	.001	.113
189.6	.993	.006	.115
198.0	.951	.043	.113
202.6	.960	.083	.106
210.6	.957	.120	.097
220.5	.956	.153	.081
230.5	.961	.181	.063
239.0	.957	.201	.042
249.0	.967	.213	.026
259.0	.971	.217	-.002
269.0	.973	.219	-.026
279.6	.961	.212	-.047
289.6	.961	.199	-.069
299.2	.958	.179	-.089
309.3	.956	.156	-.102
315.0	.959	.137	-.109
316.0	.961	.131	-.109
318.0	.961	.126	-.116
324.0	.960	.107	-.113
327.0	.972	.103	-.116
329.2	.973	.105	-.117
330.0	.969	.116	-.110
332.9	.933	.139	-.121
334.9	.868	.133	-.118
337.1	.836	.104	-.095
338.0	.860	.062	-.078
338.9	.873	.060	-.075
343.1	.884	.033	-.060
344.9	.879	.037	-.046
348.0	.866	.024	-.048
353.1	.891	.020	-.042
357.0	.829	.009	-.049
361.1	.819	-.005	-.063

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-5.0	.891	-.045	-.080
.6	.896	-.056	-.089
7.0	.920	-.075	-.110
14.5	.930	-.058	-.117
16.0	.935	-.065	-.110
18.6	.927	-.023	-.121
20.6	.886	-.021	-.127
20.6	.886	-.020	-.125
22.6	.838	-.085	-.143
24.6	.910	-.123	-.153
26.0	.953	-.109	-.156
28.6	.959	-.095	-.157
30.6	.949	-.095	-.156
32.5	.950	-.090	-.154
34.3	.956	-.103	-.152
36.0	.944	-.110	-.150
38.0	.940	-.115	-.147
42.0	.944	-.120	-.142
46.3	.956	-.130	-.135
50.5	.969	-.140	-.129
60.5	.963	-.123	-.145
68.1	.962	-.169	-.109
70.3	.956	-.106	-.087
79.0	.967	-.196	-.063
89.9	.965	-.198	-.036
99.0	.964	-.197	-.012
99.0	.964	-.196	-.012
109.6	.958	-.191	.012
119.5	.952	-.176	.038
129.3	.936	-.157	.063
139.1	.927	-.129	.083
149.0	.922	-.100	.090
158.9	.912	-.066	.110
169.1	.911	-.027	.117
179.0	.903	.013	.110
189.2	.913	.047	.110
199.2	.905	.086	.102
209.0	.906	.117	.086
219.2	.905	.150	.067
229.6	.916	.175	.041
229.6	.916	.176	.042
239.3	.932	.195	.016
249.5	.939	.206	-.018
259.1	.938	.213	-.036
269.0	.935	.216	-.066
279.0	.936	.208	-.099
289.0	.961	.196	-.116
299.0	.961	.172	-.136
309.9	.962	.145	-.153
317.0	.933	.120	-.164
321.0	.939	.107	-.167
325.0	.966	.100	-.171
329.0	.937	.110	-.179
330.0	.932	.119	-.183
331.0	.906	.115	-.179
333.9	.965	.068	-.155
335.9	.902	.029	-.140
337.9	.909	.027	-.141
339.0	.910	.031	-.141
344.1	.891	.016	-.129
348.1	.886	-.007	-.114
352.1	.885	-.025	-.099
355.0	.891	-.045	-.080
360.6	.896	-.056	-.089

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-2.9	.923	-.013	-.120
1.1	.923	-.027	-.117
5.1	.928	-.039	-.126
9.3	.943	-.047	-.127
11.3	.950	-.052	-.131
13.2	.960	-.053	-.131
15.2	.967	-.059	-.136
17.3	.974	-.060	-.136
19.0	.981	-.052	-.135
19.2	.963	-.056	-.139
19.2	.973	-.055	-.137
21.3	.945	-.029	-.136
23.3	.923	-.017	-.132
25.3	.905	-.103	-.156
27.3	.978	-.111	-.170
29.3	.949	-.093	-.175
29.6	.991	-.091	-.176
33.3	.978	-.093	-.171
37.2	.982	-.103	-.165
39.3	.979	-.109	-.162
49.6	.975	-.136	-.144
59.3	.979	-.159	-.126
69.0	.978	-.178	-.099
79.5	.978	-.196	-.076
89.7	.980	-.208	-.041
99.6	.991	-.208	-.010
109.0	.978	-.192	.023
119.6	.969	-.178	.050
129.9	.962	-.157	.079
139.0	.959	-.130	.101
149.9	.969	-.099	.119
160.2	.947	-.065	.132
170.3	.951	-.027	.137
176.2	.966	-.007	.140
180.6	.952	.005	.139
180.6	.956	.007	.140
190.6	.956	.040	.135
200.7	.951	.076	.127
210.5	.952	.100	.112
220.0	.952	.130	.093
230.6	.966	.159	.068
240.2	.967	.180	.044
250.0	.978	.190	.016
259.0	.977	.197	-.013
269.0	.986	.197	-.044
279.0	.982	.190	-.073
289.7	.979	.177	-.103
299.0	.976	.158	-.129
309.6	.980	.132	-.149
313.3	.983	.121	-.158
317.2	.983	.108	-.166
318.0	.996	.102	-.165
321.2	.996	.097	-.168
325.1	.996	.098	-.176
327.1	.957	.119	-.183
329.1	.896	.121	-.177
331.1	.910	.033	-.165
332.0	.973	.020	-.167
335.0	.977	.043	-.173
337.0	.969	.056	-.175
340.0	.955	.044	-.166
342.0	.968	.037	-.166
344.9	.939	.031	-.158
346.9	.937	.017	-.149
347.0	.936	.010	-.151
349.0	.926	.006	-.142
353.1	.919	-.007	-.128
357.1	.923	-.013	-.128
361.1	.923	-.027	-.117

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-4.0	.914	.036	-.140
.1	.896	.019	-.135
4.3	.877	-.001	-.135
8.0	.963	-.021	-.141
12.0	.967	-.040	-.149
16.2	.898	-.054	-.153
18.9	.904	-.057	-.161
20.4	.996	-.063	-.163
20.5	.918	-.061	-.164
22.4	.939	-.050	-.166
24.0	.925	-.020	-.163
26.0	.867	-.096	-.175
28.5	.940	-.114	-.196
30.3	.975	-.091	-.198
32.5	.968	-.087	-.196
34.0	.969	-.090	-.192
36.0	.966	-.095	-.189
38.0	.957	-.101	-.180
46.6	.969	-.118	-.171
54.3	.967	-.135	-.156
60.1	.964	-.140	-.145
62.1	.966	-.151	-.141
70.0	.970	-.166	-.121
77.0	.973	-.177	-.100
79.7	.972	-.179	-.095
85.7	.976	-.185	-.077
99.6	.978	-.189	-.031
103.0	.979	-.197	-.025
109.0	.976	-.183	-.001
117.2	.977	-.176	.025
119.1	.973	-.170	.031
132.0	.967	-.142	.071
138.0	.960	-.127	.086
141.0	.959	-.122	.091
149.0	.953	-.100	.107
156.0	.951	-.076	.119
158.0	.954	-.060	.121
166.9	.958	-.047	.127
172.9	.956	-.020	.133
178.9	.954	.001	.133
181.0	.952	.008	.134
189.0	.956	.035	.130
197.0	.951	.062	.123
199.0	.967	.068	.122
205.1	.956	.087	.113
213.1	.958	.110	.100
219.1	.963	.127	.089
221.2	.957	.132	.084
229.2	.968	.151	.063
237.2	.972	.168	.041
239.2	.973	.169	.037
245.2	.976	.179	.018
253.3	.971	.189	-.006
259.1	.969	.192	-.022
261.2	.976	.193	-.030
269.0	.976	.194	-.055
277.0	.969	.191	-.082
279.3	.963	.190	-.089
285.4	.967	.182	-.103
293.0	.959	.170	-.132
293.0	.961	.170	-.132
299.3	.965	.157	-.148
301.0	.963	.152	-.153
301.5	.962	.152	-.156
309.5	.966	.131	-.171
317.5	.966	.106	-.187
319.5	.971	.100	-.189
321.5	.965	.096	-.191
323.7	.969	.093	-.196
325.0	.971	.101	-.197
327.7	.977	.129	-.192
331.7	.972	.027	-.188
333.7	.981	.096	-.187
335.7	.966	.086	-.192
337.7	.970	.069	-.186
339.0	.967	.067	-.184
339.0	.969	.068	-.186
343.0	.951	.063	-.175
347.9	.936	.053	-.162
351.0	.925	.043	-.149
356.0	.919	.036	-.140
360.1	.886	.019	-.135

TABLE D-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 12

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.949	.930	.964	.957	1.013	.992	.969	.938	.928	.950	.966	.966	.957
VTBAR =	-.006	.001	-.002	.003	-.022	-.017	-.012	-.003	.001	-.001	-.002	-.000	.003
VRBAR =	-.009	-.033	-.027	-.043	.035	.021	.005	-.018	-.031	-.029	-.028	-.035	-.043
1-WVX =	.975	.949	.948	.954	0.000	1.002	.988	.967	.952	.947	.950	.954	.956
1-WX =	.997	.960	.955	.959	0.000	1.035	1.014	.984	.964	.956	.958	.960	.961
BBAR =	26.15	19.05	16.20	13.14	37.82	33.99	29.82	23.84	19.99	17.71	15.86	14.16	12.67
BPOS =	3.71	2.14	1.25	.92	10.55	7.89	4.97	3.19	2.38	1.63	1.18	.96	.87
THETA =	92.50	82.50	95.00	102.50	20.00	22.50	22.50	92.50	82.50	95.00	95.00	97.50	102.50
BNEG =	-3.59	-2.13	-1.40	-1.17	-12.54	-9.19	-5.82	-2.67	-2.31	-1.42	-1.34	-.92	-1.13
THETA =	337.50	332.50	330.00	7.50	5.00	5.00	5.00	335.00	332.50	330.00	330.00	327.50	7.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE D-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 12

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0247	.0352	.0210	.0181	.0171	.0121	.0064	.0039
PHASE ANGLE =	285.3	274.5	276.0	273.2	271.1	269.3	263.1	214.0
RADIUS = .633								
AMPLITUDE =	.0132	.0254	.0061	.0039	.0061	.0034	.0023	.0021
PHASE ANGLE =	16.3	271.1	280.1	300.8	303.7	22.8	91.3	32.0
RADIUS = .781								
AMPLITUDE =	.0025	.0177	.0070	.0054	.0072	.0025	.0014	.0018
PHASE ANGLE =	87.3	272.0	284.1	302.6	279.1	312.4	308.4	346.4
RADIUS = .963								
AMPLITUDE =	.0123	.0217	.0101	.0097	.0106	.0077	.0056	.0046
PHASE ANGLE =	268.4	261.6	232.3	228.6	236.1	213.3	214.1	192.1

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0054	.0061	.0076	.0067	.0048	.0022	.0004	.0019
PHASE ANGLE =	191.3	151.6	150.6	148.9	147.1	147.5	209.0	333.7
RADIUS = .633								
AMPLITUDE =	.0032	.0023	.0010	.0009	.0021	.0039	.0036	.0045
PHASE ANGLE =	73.7	56.3	67.6	5.8	326.9	304.7	307.0	294.8
RADIUS = .781								
AMPLITUDE =	.0009	.0013	.0012	.0029	.0031	.0032	.0015	.0011
PHASE ANGLE =	261.2	216.8	282.3	300.4	315.0	306.3	301.4	357.0
RADIUS = .963								
AMPLITUDE =	.0028	.0024	.0005	.0001	.0004	.0011	.0013	.0006
PHASE ANGLE =	193.3	211.3	247.2	221.6	216.9	339.8	69.5	68.4

TABLE D-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 12

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0712	.0440	.0458	.0430	.0390	.0373	.0236	.0146
PHASE ANGLE =	257.5	278.5	275.8	270.4	260.0	259.6	267.4	218.2
RADIUS = .350								
AMPLITUDE =	.0560	.0416	.0382	.0353	.0321	.0294	.0182	.0112
PHASE ANGLE =	261.7	277.4	275.8	270.8	262.0	260.9	266.8	217.5
RADIUS = .400								
AMPLITUDE =	.0391	.0385	.0293	.0264	.0242	.0203	.0120	.0074
PHASE ANGLE =	269.7	276.0	275.9	271.6	265.4	263.5	265.6	216.2
RADIUS = .500								
AMPLITUDE =	.0174	.0327	.0156	.0128	.0127	.0071	.0030	.0017
PHASE ANGLE =	306.0	273.4	276.3	275.6	277.6	279.3	257.8	209.6
RADIUS = .600								
AMPLITUDE =	.0133	.0271	.0076	.0051	.0070	.0029	.0018	.0016
PHASE ANGLE =	4.2	271.5	278.6	290.8	298.3	4.5	97.1	36.0
RADIUS = .700								
AMPLITUDE =	.0071	.0207	.0067	.0051	.0067	.0031	.0011	.0023
PHASE ANGLE =	37.8	272.5	288.6	311.6	294.5	354.8	32.3	7.6
RADIUS = .800								
AMPLITUDE =	.0018	.0174	.0070	.0054	.0073	.0025	.0015	.0015
PHASE ANGLE =	113.3	271.4	280.9	297.4	274.9	298.4	293.7	338.6
RADIUS = .900								
AMPLITUDE =	.0059	.0186	.0079	.0065	.0088	.0046	.0033	.0018
PHASE ANGLE =	249.6	266.7	252.6	253.0	250.5	232.1	234.3	211.0
RADIUS = 1.000								
AMPLITUDE =	.0123	.0217	.0101	.0097	.0106	.0077	.0056	.0046
PHASE ANGLE =	268.4	261.6	232.3	228.6	236.1	213.3	214.1	192.1

TABLE D-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0199	.0184	.0190	.0171	.0152	.0123	.0080	.0083
PHASE ANGLE =	215.4	174.5	161.3	158.0	149.4	134.6	134.9	85.5
RADIUS = .350								
AMPLITUDE =	.0151	.0144	.0155	.0140	.0120	.0091	.0055	.0054
PHASE ANGLE =	212.5	171.1	159.4	156.3	149.0	135.6	136.1	79.1
RADIUS = .400								
AMPLITUDE =	.0099	.0099	.0114	.0102	.0084	.0055	.0027	.0025
PHASE ANGLE =	206.2	164.6	156.1	153.4	148.3	138.0	140.1	54.8
RADIUS = .500								
AMPLITUDE =	.0031	.0040	.0051	.0043	.0025	.0006	.0015	.0031
PHASE ANGLE =	163.6	133.4	143.9	143.2	145.5	229.2	298.5	307.3
RADIUS = .600								
AMPLITUDE =	.0031	.0025	.0015	.0007	.0013	.0033	.0034	.0046
PHASE ANGLE =	83.2	70.0	102.1	76.1	329.6	303.1	306.6	295.3
RADIUS = .700								
AMPLITUDE =	.0010	.0005	.0005	.0021	.0029	.0037	.0026	.0024
PHASE ANGLE =	56.3	78.6	320.8	310.8	319.4	304.7	302.7	308.7
RADIUS = .800								
AMPLITUDE =	.0012	.0015	.0013	.0029	.0030	.0030	.0013	.0010
PHASE ANGLE =	253.1	218.2	279.9	299.2	314.1	307.0	302.8	13.6
RADIUS = .900								
AMPLITUDE =	.0022	.0024	.0011	.0018	.0016	.0019	.0005	.0010
PHASE ANGLE =	219.1	216.7	270.0	294.1	304.9	316.3	34.5	61.3
RADIUS = 1.000								
AMPLITUDE =	.0028	.0024	.0005	.0001	.0004	.0011	.0013	.0006
PHASE ANGLE =	193.3	211.3	247.2	221.6	216.9	339.8	69.5	68.4

TABLE D-5 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 12

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2264	.0041	.0017	.0055	.0019	.0046	.0014	.0020
PHASE ANGLE =	182.3	7.8	197.5	182.4	181.9	167.6	152.7	99.5
RADIUS = .633								
AMPLITUDE =	.2044	.0141	.0065	.0061	.0060	.0049	.0045	.0032
PHASE ANGLE =	184.9	319.9	298.6	293.4	296.9	286.6	298.6	309.8
RADIUS = .781								
AMPLITUDE =	.1937	.0122	.0065	.0029	.0017	.0015	.0013	.0008
PHASE ANGLE =	182.4	349.8	329.2	288.7	296.7	267.8	302.0	287.4
RADIUS = .963								
AMPLITUDE =	.1865	.0096	.0028	.0033	.0041	.0033	.0021	.0018
PHASE ANGLE =	180.0	6.5	17.4	124.8	132.7	132.8	139.3	132.5

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0033	.0038	.0050	.0051	.0047	.0030	.0019	.0009
PHASE ANGLE =	49.3	54.7	47.1	50.3	63.5	50.9	81.0	233.6
RADIUS = .633								
AMPLITUDE =	.0027	.0015	.0012	.0015	.0023	.0030	.0032	.0029
PHASE ANGLE =	308.1	292.4	265.3	211.8	203.8	199.1	198.4	198.1
RADIUS = .781								
AMPLITUDE =	.0010	.0004	.0006	.0013	.0014	.0017	.0010	.0006
PHASE ANGLE =	306.9	191.2	204.1	192.5	198.1	214.2	194.7	202.9
RADIUS = .963								
AMPLITUDE =	.0010	.0010	.0012	.0010	.0013	.0007	.0009	.0002
PHASE ANGLE =	119.2	169.4	152.8	203.8	197.8	205.4	235.4	357.8

TABLE D-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 12

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2533	.0234	.0174	.0226	.0167	.0203	.0134	.0123
PHASE ANGLE =	176.9	103.7	122.1	150.4	133.0	139.3	126.8	118.9
RADIUS = .350								
AMPLITUDE =	.2453	.0159	.0121	.0170	.0118	.0152	.0095	.0090
PHASE ANGLE =	178.6	99.6	125.1	153.6	135.4	142.1	128.0	117.4
RADIUS = .400								
AMPLITUDE =	.2358	.0077	.0061	.0107	.0063	.0095	.0052	.0053
PHASE ANGLE =	180.5	84.2	133.8	161.2	142.4	148.6	131.5	113.7
RADIUS = .500								
AMPLITUDE =	.2200	.0072	.0034	.0035	.0024	.0026	.0013	.0008
PHASE ANGLE =	183.5	323.7	273.6	224.3	268.4	211.7	276.6	14.5
RADIUS = .600								
AMPLITUDE =	.2078	.0132	.0079	.0056	.0058	.0045	.0042	.0030
PHASE ANGLE =	184.9	318.6	295.0	288.2	295.1	281.9	297.5	312.4
RADIUS = .700								
AMPLITUDE =	.1990	.0129	.0075	.0048	.0041	.0033	.0030	.0021
PHASE ANGLE =	183.8	334.9	313.2	292.3	298.2	283.5	300.9	304.4
RADIUS = .800								
AMPLITUDE =	.1926	.0121	.0062	.0024	.0012	.0011	.0010	.0006
PHASE ANGLE =	182.1	352.6	332.7	286.8	293.7	256.1	301.0	275.1
RADIUS = .900								
AMPLITUDE =	.1883	.0109	.0043	.0010	.0020	.0018	.0010	.0010
PHASE ANGLE =	180.7	3.2	353.4	143.0	134.0	143.1	139.5	143.2
RADIUS = 1.000								
AMPLITUDE =	.1865	.0096	.0028	.0033	.0041	.0033	.0021	.0018
PHASE ANGLE =	180.0	6.5	17.4	124.8	132.7	132.8	139.3	132.5

TABLE D-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5365 WITH BASS BOAT BEHIND WPROP 12
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0115	.0124	.0150	.0159	.0163	.0132	.0105	.0051
PHASE ANGLE =	80.3	71.7	55.3	48.9	53.4	35.3	43.8	2.5
RADIUS = .350								
AMPLITUDE =	.0088	.0097	.0119	.0126	.0127	.0100	.0077	.0033
PHASE ANGLE =	76.5	69.3	54.1	49.0	54.6	36.9	46.7	358.5
RADIUS = .400								
AMPLITUDE =	.0058	.0066	.0083	.0097	.0085	.0063	.0045	.0013
PHASE ANGLE =	68.4	64.6	51.7	49.3	57.2	40.5	54.1	341.5
RADIUS = .500								
AMPLITUDE =	.0023	.0022	.0029	.0023	.0024	.0012	.0014	.0018
PHASE ANGLE =	18.8	37.9	39.5	52.8	77.2	86.3	144.6	208.6
RADIUS = .600								
AMPLITUDE =	.0026	.0014	.0008	.0008	.0018	.0025	.0030	.0029
PHASE ANGLE =	315.7	308.4	291.6	203.2	194.2	194.4	195.1	199.0
RADIUS = .700								
AMPLITUDE =	.0020	.0007	.0008	.0014	.0018	.0023	.0020	.0017
PHASE ANGLE =	307.3	275.5	246.0	200.4	201.3	206.2	195.7	199.0
RADIUS = .800								
AMPLITUDE =	.0008	.0005	.0007	.0013	.0013	.0016	.0008	.0005
PHASE ANGLE =	307.1	178.4	194.0	191.6	197.5	215.8	196.1	205.5
RADIUS = .900								
AMPLITUDE =	.0003	.0009	.0009	.0011	.0012	.0010	.0006	.0002
PHASE ANGLE =	115.3	163.3	161.3	193.9	196.3	217.7	224.4	351.9
RADIUS = 1.000								
AMPLITUDE =	.0010	.0010	.0012	.0010	.0013	.0007	.0009	.0002
PHASE ANGLE =	119.2	163.4	152.8	203.8	197.8	205.4	235.4	357.8

APPENDIX E

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 13

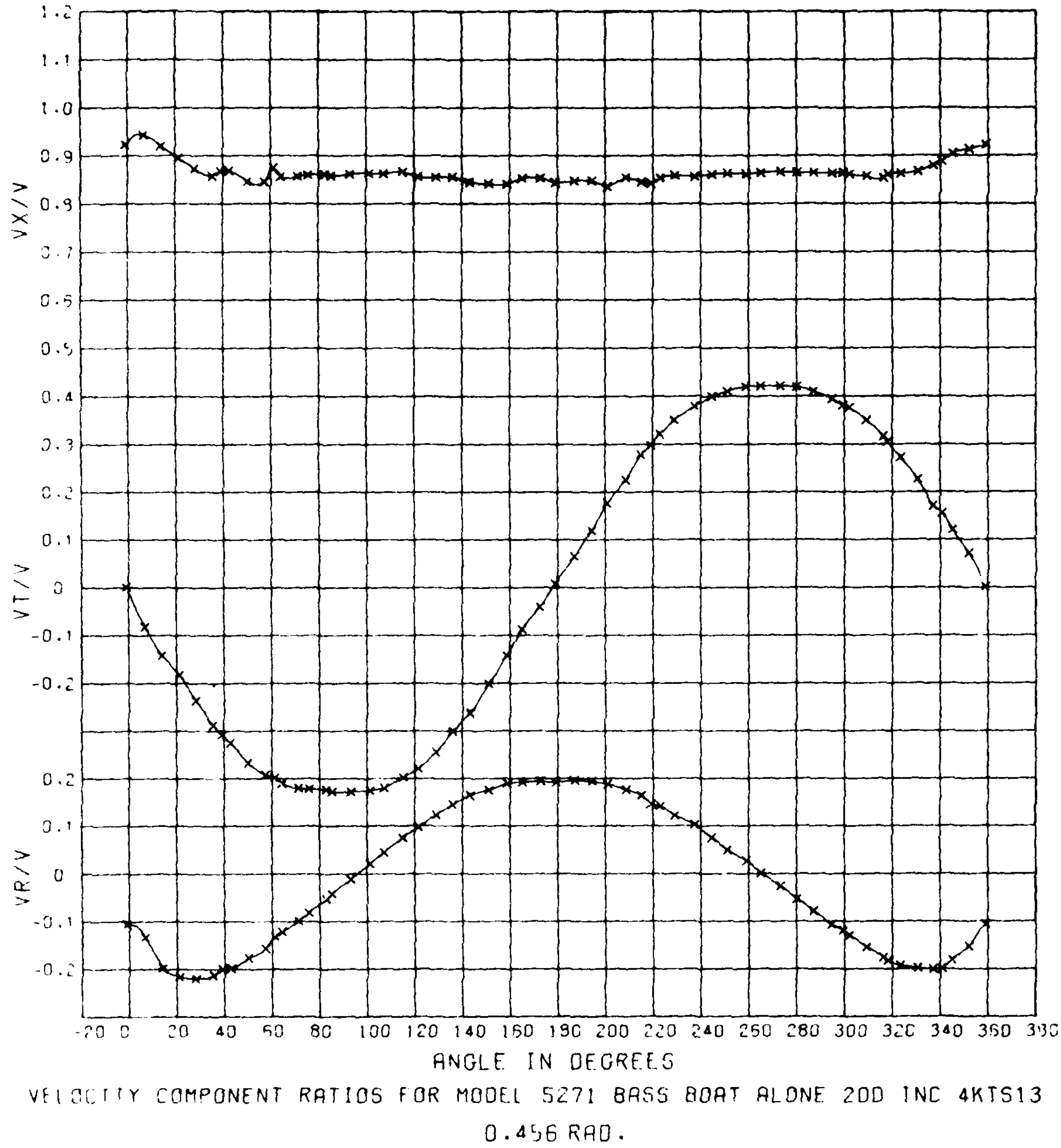

Figure E-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 13

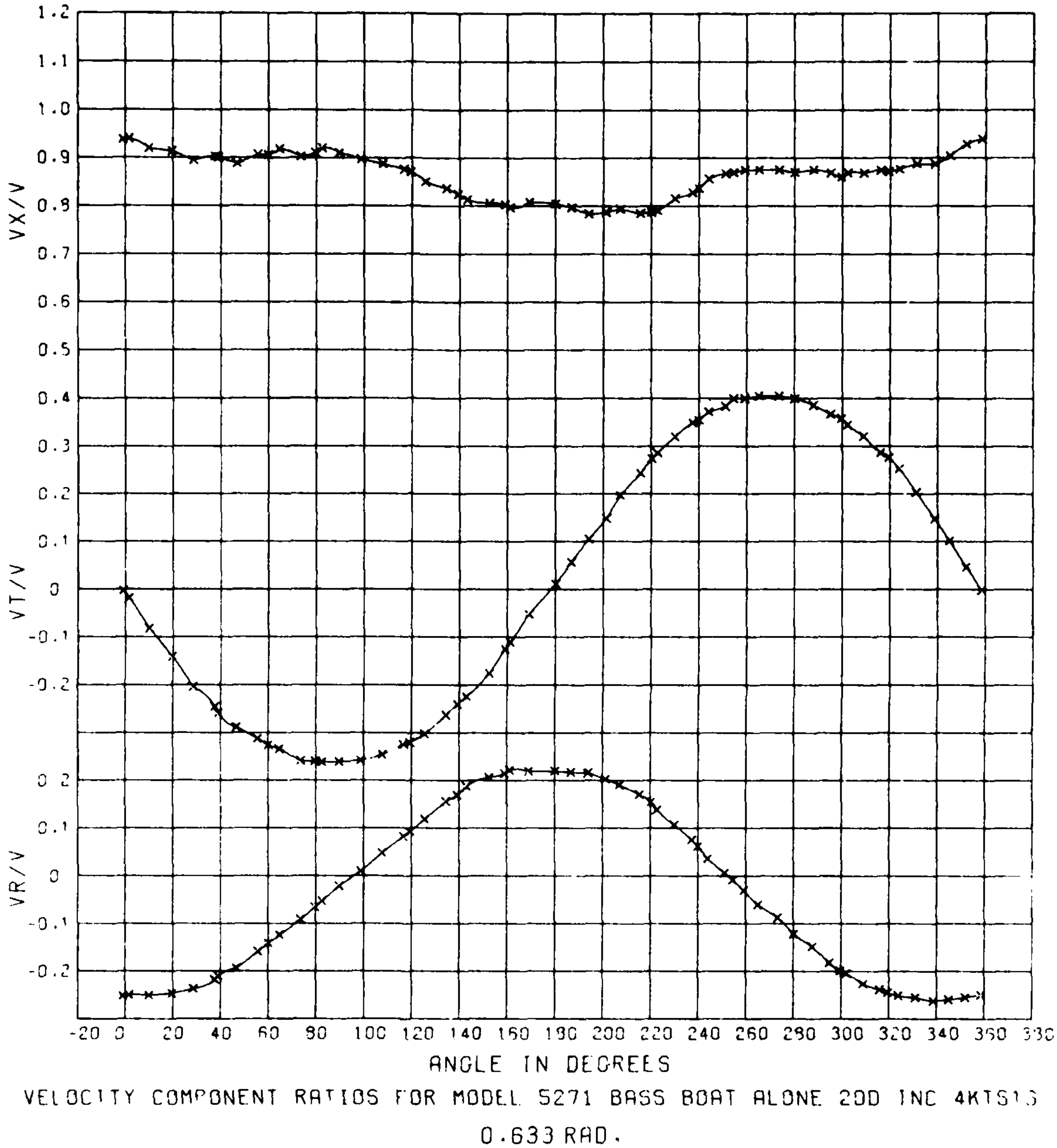

Figure E-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 13

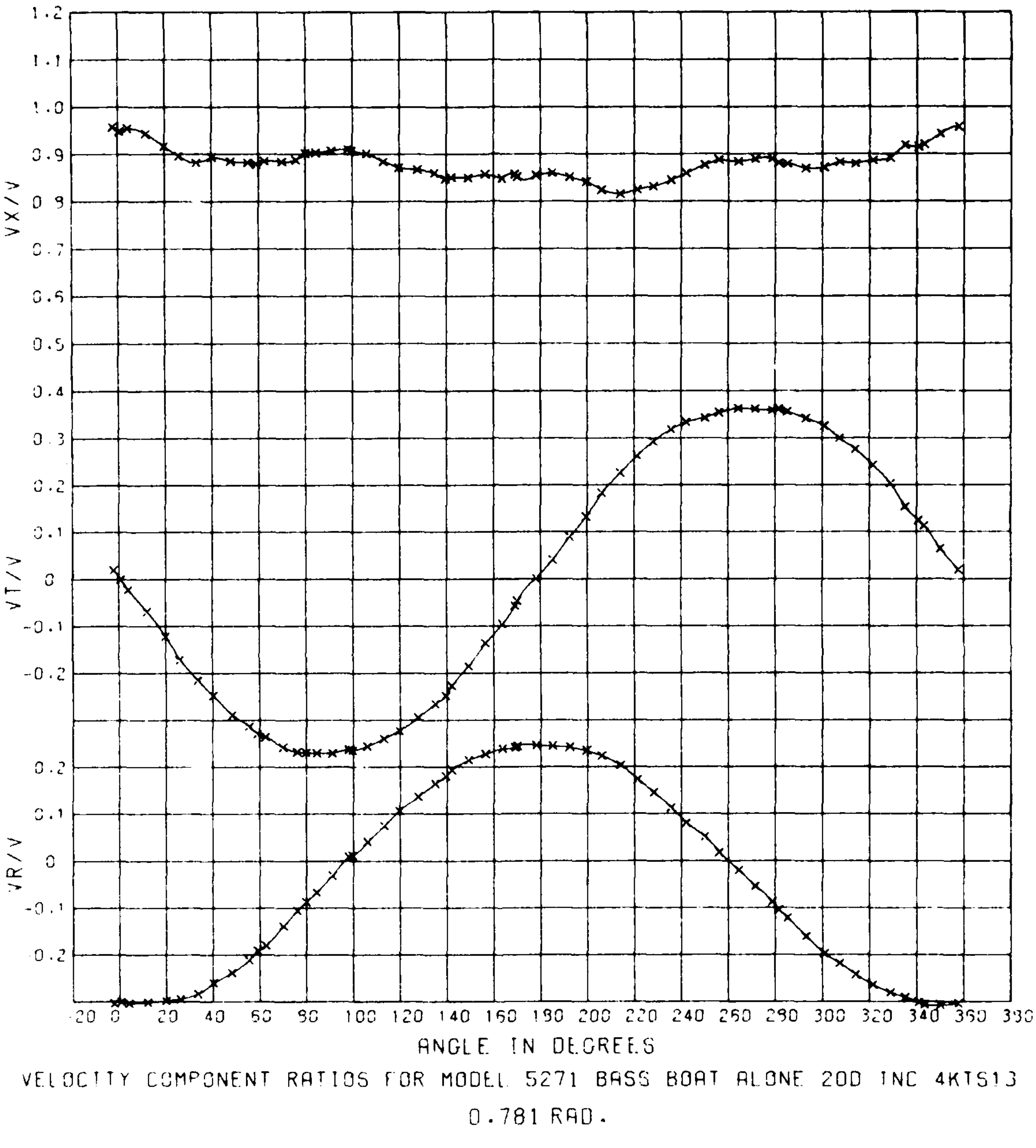

Figure E-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 13

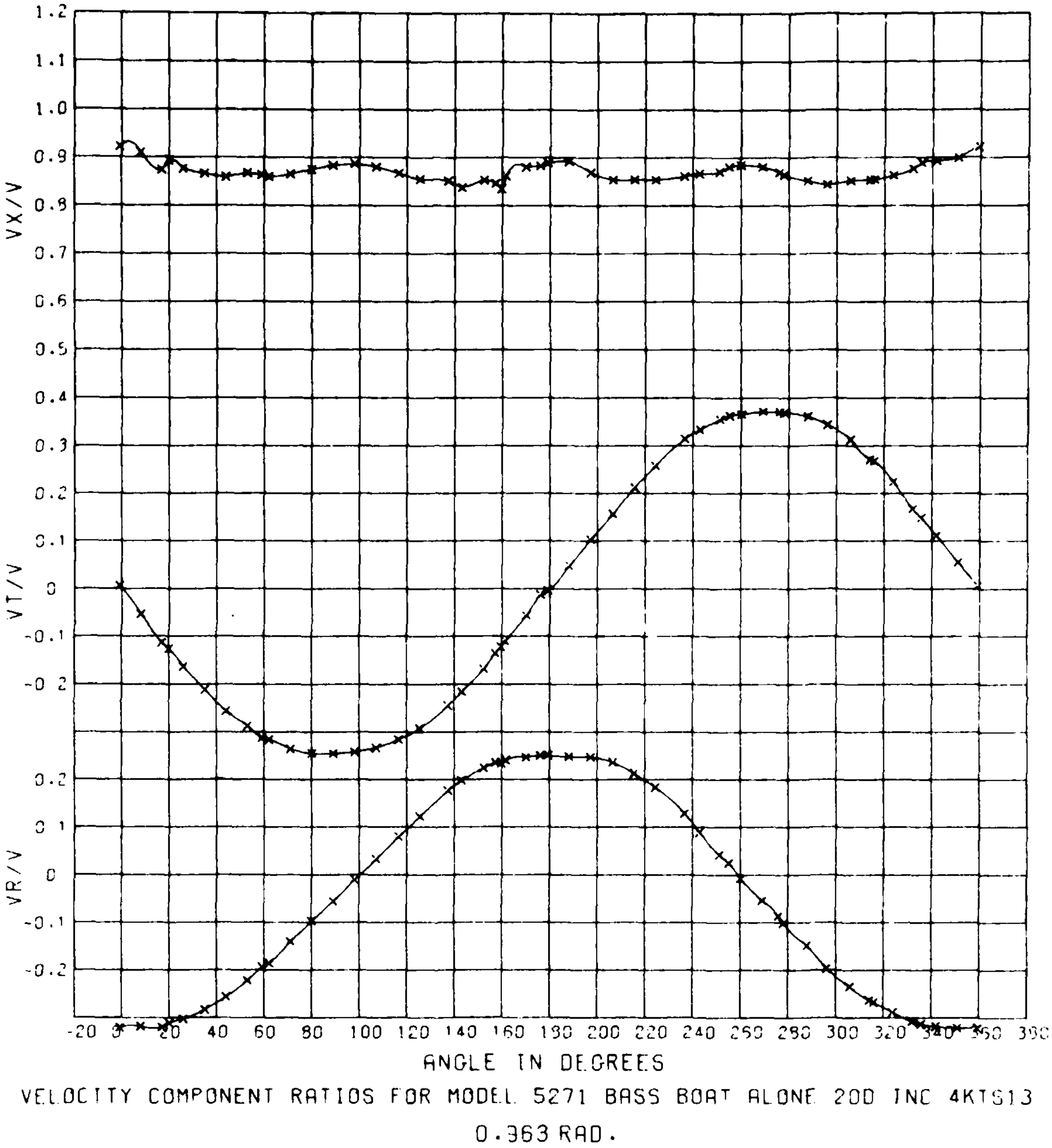

Figure E-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 13

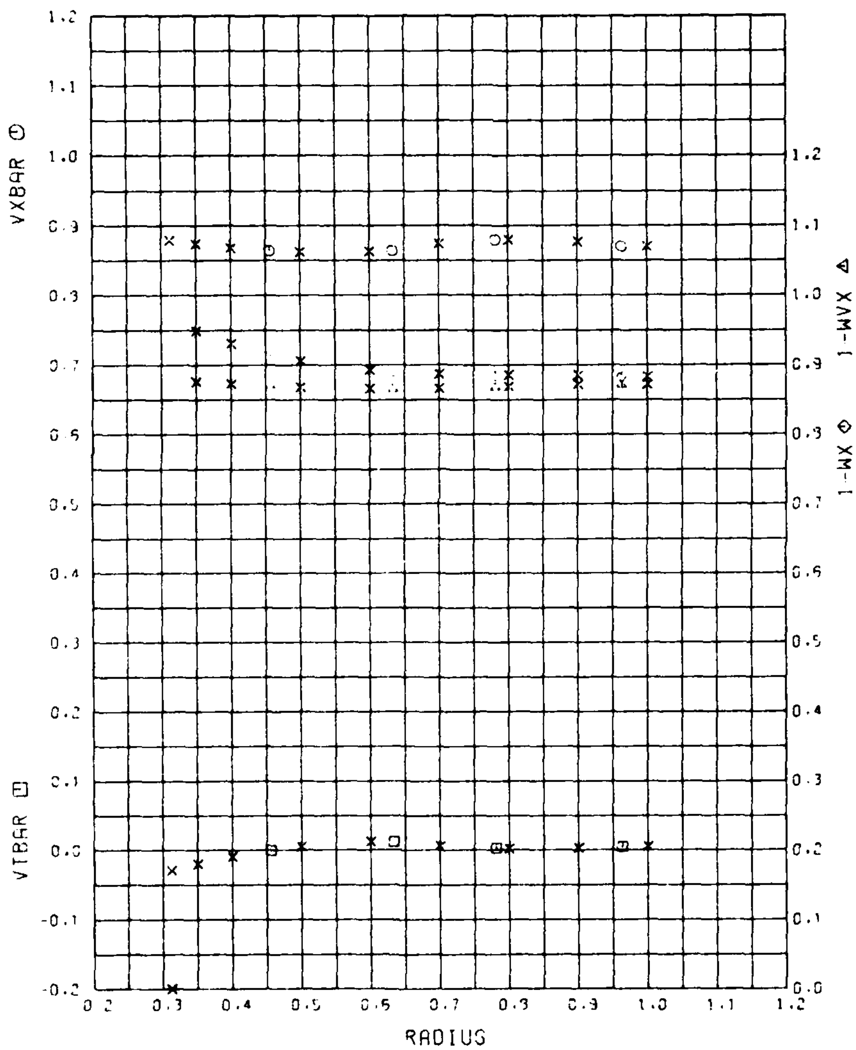

Figure E-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 13

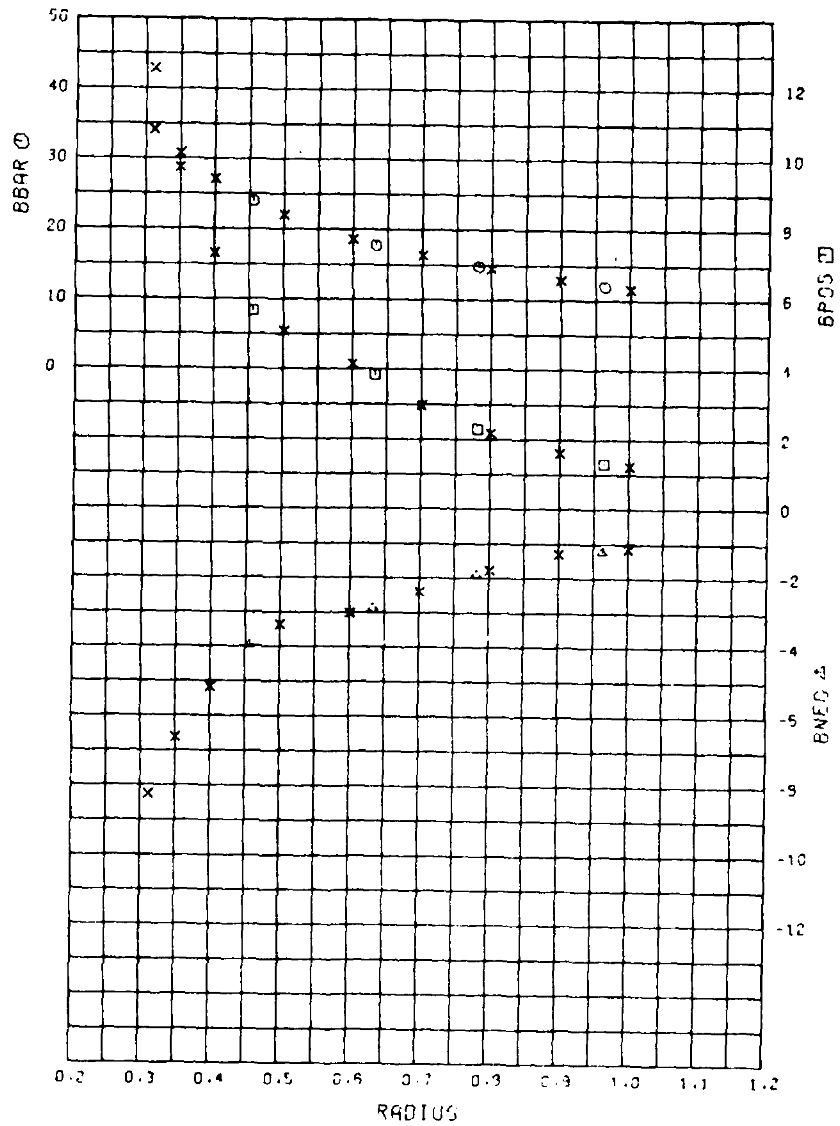

Figure E-6 - Radial Distribution of the Mean Advance Angles and Advance Angle Variations for Experiment 13

TABLE E -1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA
WITH BASS DYNAMOMETER BOAT, EXPERIMENT 13

ANGLE	RADIUS = .496 VX/V	VT/V	VR/V
-1.0	.923	.001	-.106
6.0	.943	-.002	-.133
13.4	.923	-.142	-.190
21.1	.896	-.183	-.216
28.0	.871	-.236	-.220
35.4	.857	-.288	-.213
39.0	.868	-.308	-.200
47.6	.868	-.326	-.190
49.0	.866	-.367	-.176
57.2	.865	-.392	-.157
61.0	.875	-.398	-.131
66.0	.855	-.418	-.122
71.0	.857	-.428	-.099
79.6	.859	-.422	-.081
82.6	.862	-.421	-.053
85.0	.858	-.427	-.041
93.0	.861	-.428	-.012
101.0	.863	-.425	.021
107.0	.862	-.428	.065
115.0	.864	-.397	.076
121.0	.857	-.382	.093
122.2	.856	-.375	.107
129.0	.856	-.345	.126
136.0	.856	-.300	.146
143.0	.866	-.262	.165
151.0	.862	-.202	.176
158.0	.860	-.163	.191
159.2	.861	-.141	.188
165.0	.853	-.087	.192
172.6	.853	-.041	.196
179.0	.861	.009	.192
188.9	.867	.065	.196
194.2	.867	.121	.195
200.5	.857	.171	.187
201.0	.838	.183	.190
208.5	.856	.226	.176
215.0	.865	.278	.166
219.0	.861	.299	.156
222.9	.857	.321	.161
229.0	.859	.351	.122
237.3	.858	.379	.107
244.5	.861	.400	.075
251.0	.861	.418	.049
258.9	.861	.428	.027
265.0	.866	.421	.001
273.7	.866	.421	-.026
280.0	.865	.420	-.053
287.0	.866	.418	-.078
294.6	.865	.395	-.107
299.3	.865	.381	-.128
301.9	.861	.376	-.129
309.1	.858	.350	-.155
316.7	.853	.317	-.176
318.0	.860	.306	-.193
323.6	.862	.272	-.192
330.6	.867	.227	-.198
337.0	.879	.171	-.208
340.0	.888	.156	-.199
345.0	.906	.121	-.181
352.0	.913	.072	-.151
359.0	.923	.001	-.106
366.0	.943	-.002	-.133

ANGLE	RADIUS = .633 VX/V	VT/V	VR/V
-1.0	.937	-.003	-.252
1.5	.939	-.018	-.258
10.0	.920	-.082	-.251
19.6	.916	-.161	-.247
28.5	.895	-.206	-.237
37.5	.881	-.246	-.218
39.0	.901	-.260	-.210
46.6	.888	-.288	-.196
55.6	.907	-.313	-.159
59.9	.906	-.326	-.142
66.0	.919	-.336	-.126
73.5	.907	-.359	-.091
79.6	.911	-.360	-.066
82.6	.920	-.361	-.052
89.6	.911	-.361	-.021
98.6	.898	-.350	.018
107.6	.887	-.366	.048
116.5	.876	-.329	.083
119.3	.871	-.321	.093
125.6	.851	-.303	.119
136.3	.837	-.263	.156
139.1	.825	-.261	.170
143.0	.813	-.229	.187
152.3	.807	-.176	.207
158.9	.803	-.125	.215
161.0	.797	-.111	.222
169.0	.807	-.057	.220
179.6	.805	.005	.222
180.9	.806	.017	.228
186.6	.797	.057	.218
193.0	.783	.105	.216
201.1	.787	.149	.203
207.0	.796	.197	.191
215.6	.785	.266	.171
220.1	.787	.276	.155
222.6	.798	.286	.138
229.9	.816	.328	.107
237.3	.828	.349	.076
239.9	.837	.356	.061
244.0	.857	.372	.036
251.0	.866	.381	.006
251.0	.868	.385	.009
256.6	.870	.400	-.009
259.0	.875	.400	-.038
265.0	.875	.405	-.060
273.6	.875	.405	-.087
280.0	.870	.400	-.122
287.0	.874	.388	-.149
295.0	.869	.367	-.183
299.5	.862	.350	-.199
302.2	.868	.344	-.206
309.0	.868	.321	-.226
316.0	.876	.288	-.239
319.6	.871	.276	-.245
323.0	.877	.242	-.251
331.0	.888	.286	-.255
338.0	.886	.151	-.261
339.2	.888	.165	-.262
345.0	.906	.101	-.268
352.0	.929	.047	-.255
358.0	.941	.001	-.248
359.0	.937	-.003	-.252
361.5	.939	-.018	-.258

ANGLE	RADIUS = .781 VX/V	VT/V	VR/V
-2.4	.957	.020	-.306
.6	.968	-.001	-.308
6.0	.956	-.022	-.303
12.0	.963	-.069	-.302
19.2	.926	-.116	-.298
20.4	.907	-.127	-.299
26.0	.896	-.172	-.296
33.6	.881	-.216	-.286
40.0	.896	-.250	-.260
40.2	.896	-.266	-.260
48.1	.885	-.289	-.239
55.6	.882	-.316	-.211
59.0	.878	-.330	-.192
62.9	.885	-.336	-.180
69.9	.886	-.350	-.130
76.0	.887	-.366	-.106
79.0	.902	-.369	-.087
86.3	.903	-.370	-.067
91.0	.907	-.371	-.031
98.0	.910	-.363	.009
99.6	.907	-.366	.011
106.0	.901	-.356	.041
113.2	.886	-.348	.075
119.0	.883	-.325	.106
120.6	.859	-.323	.109
127.6	.867	-.296	.137
136.0	.860	-.265	.165
139.6	.867	-.268	.180
142.0	.850	-.227	.196
149.2	.869	-.186	.215
156.6	.857	-.136	.224
163.6	.847	-.096	.239
169.0	.857	-.058	.243
169.0	.861	-.057	.239
170.0	.851	-.047	.246
176.0	.852	.003	.247
178.1	.857	-.002	.249
185.0	.862	.042	.247
189.1	.858	.048	.243
192.6	.850	.089	.242
199.5	.861	.132	.235
206.0	.876	.183	.226
213.9	.915	.226	.203
221.1	.874	.261	.173
228.0	.831	.293	.146
235.9	.846	.310	.113
242.0	.859	.333	.080
249.9	.876	.343	.051
256.0	.887	.356	.010
264.2	.886	.362	-.028
271.6	.889	.361	-.056
278.6	.890	.358	-.087
281.3	.880	.361	-.106
289.0	.879	.356	-.122
292.9	.869	.342	-.161
300.0	.867	.331	-.196
301.2	.880	.321	-.190
307.3	.892	.300	-.218
314.0	.879	.276	-.247
321.0	.886	.266	-.266
321.6	.889	.248	-.266
328.0	.891	.206	-.281
335.0	.919	.156	-.291
340.0	.916	.175	-.301
343.2	.928	.113	-.306
350.0	.941	.066	-.307
357.6	.957	.020	-.306
360.6	.968	-.001	-.308

ANGLE	RADIUS = .963 VX/V	VT/V	VR/V
-.0	.922	.006	-.321
0.0	.989	-.094	-.318
17.0	.873	-.114	-.321
20.0	.896	-.126	-.312
26.0	.876	-.164	-.303
39.0	.866	-.213	-.286
46.0	.859	-.297	-.257
53.0	.867	-.288	-.223
59.0	.863	-.313	-.199
67.0	.860	-.316	-.186
71.0	.862	-.339	-.161
71.0	.869	-.333	-.160
80.0	.875	-.349	-.097
89.0	.883	-.346	-.056
98.0	.887	-.342	-.018
107.0	.888	-.333	.033
116.5	.867	-.316	.088
129.4	.855	-.292	.123
137.3	.852	-.269	.177
143.0	.816	-.218	.201
143.0	.859	-.213	.197
152.3	.853	-.169	.225
157.2	.866	-.138	.236
159.6	.825	-.125	.235
159.6	.863	-.120	.236
161.4	.862	-.110	.241
170.0	.880	-.096	.247
176.0	.882	-.013	.250
179.3	.888	-.006	.251
188.0	.893	.060	.248
197.0	.868	.106	.240
206.4	.853	.157	.237
215.4	.853	.212	.213
224.2	.853	.290	.166
230.4	.861	.319	.129
242.6	.866	.373	.089
251.0	.870	.395	.042
255.0	.881	.363	.025
260.0	.885	.366	-.008
269.0	.888	.371	-.056
276.0	.869	.378	-.086
278.0	.866	.378	-.102
287.0	.851	.361	-.149
296.0	.863	.343	-.198
305.0	.852	.316	-.235
314.0	.853	.271	-.266
319.0	.856	.260	-.260
323.0	.862	.226	-.289
332.0	.875	.167	-.300
335.6	.889	.149	-.313
341.0	.893	.112	-.310
350.0	.899	.095	-.321
359.2	.922	.006	-.321
360.0	.989	-.094	-.310

TABLE E-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 13

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 20D INC 4KTS13
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.864	.864	.880	.870	.879	.874	.868	.862	.863	.874	.880	.877	.870
VTBAR =	-.000	.012	.003	.005	-.029	-.020	-.009	.005	.012	.006	.002	.003	.005
VRBAR =	-.011	-.035	-.039	-.044	.024	.013	.001	-.019	-.032	-.037	-.039	-.042	-.044
1-WVX =	.870	.865	.868	.871	0.000	.876	.873	.868	.866	.866	.869	.872	.872
1-WX =	.920	.890	.885	.883	0.000	.949	.931	.906	.893	.887	.886	.885	.883
BBAR =	24.02	17.73	14.82	11.98	34.09	30.74	27.17	22.02	18.60	16.33	14.50	12.90	11.55
BPOS =	5.67	3.84	2.30	1.31	12.57	9.75	7.31	5.06	4.15	2.97	2.18	1.62	1.23
THETA =	97.50	85.00	95.00	97.50	110.00	105.00	105.00	85.00	85.00	85.00	95.00	95.00	97.50
BNEG =	-3.96	-2.87	-1.89	-1.23	-8.26	-6.63	-5.17	-3.36	-3.02	-2.40	-1.77	-1.30	-1.16
THETA =	260.00	220.00	217.50	295.00	315.00	290.00	260.00	237.50	220.00	220.00	227.50	295.00	295.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE E-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 13

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 200 INC 4KTS13
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0209	.0087	.0147	.0120	.0097	.0055	.0023	.0014
PHASE ANGLE =	92.7	88.8	82.7	[illegible]	59.4	84.8	29.1	62.0
RADIUS = .633								
AMPLITUDE =	.0575	.0179	[illegible]	[illegible]	.0011	.0057	.0018	.0016
PHASE ANGLE =	71.8	272.4	[illegible]	[illegible]	251.7	66.8	87.9	134.4
RADIUS = .781								
AMPLITUDE =	.0368	.0060	.0117	[illegible]	.0018	.0034	.0041	.0039
PHASE ANGLE =	75.6	172.8	[illegible]	[illegible]	254.8	64.8	112.2	48.1
RADIUS = .963								
AMPLITUDE =	.0086	.0084	[illegible]	[illegible]	.0052	.0033	.0013	.0043
PHASE ANGLE =	72.2	68.6	104.5	[illegible]	249.4	92.4	64.7	93.4

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0018	.0010	.0024	.0013	.0007	.0021	.0013	.0009
PHASE ANGLE =	21.6	38.8	13.2	300.5	325.1	280.5	226.0	355.0
RADIUS = .633								
AMPLITUDE =	.0020	.0024	.0006	.0025	.0011	.0005	.0020	.0019
PHASE ANGLE =	50.1	132.8	[illegible]	113.2	357.6	50.6	223.0	145.4
RADIUS = .781								
AMPLITUDE =	.0012	.0017	.0002	.0026	.0007	.0011	.0014	.0014
PHASE ANGLE =	72.5	320.7	[illegible]	328.2	123.4	147.6	214.5	162.5
RADIUS = .963								
AMPLITUDE =	.0010	.0004	.0018	.0012	.0027	.0026	.0023	.0011
PHASE ANGLE =	255.4	34.0	80.0	71.6	90.8	49.3	79.8	30.5

TABLE E-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 13

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 20D INC 4KTS13
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0656	.0698	.0239	.0173	.0161	.0049	.0041	.0078
PHASE ANGLE =	232.4	95.9	85.3	41.6	69.2	129.2	27.0	24.7
RADIUS = .350								
AMPLITUDE =	.0400	.0502	.0210	.0149	.0129	.0048	.0036	.0056
PHASE ANGLE =	226.2	95.3	84.7	49.4	69.2	113.9	25.8	27.4
RADIUS = .400								
AMPLITUDE =	.0139	.0282	.0177	.0128	.0092	.0051	.0030	.0032
PHASE ANGLE =	191.0	94.0	85.8	62.0	69.3	97.5	25.7	35.0
RADIUS = .500								
AMPLITUDE =	.0356	.0031	.0128	.0122	.0034	.0058	.0019	.0011
PHASE ANGLE =	79.2	292.6	82.0	87.7	69.4	77.9	36.6	111.6
RADIUS = .600								
AMPLITUDE =	.0556	.0170	.0103	.0143	.0003	.0059	.0016	.0016
PHASE ANGLE =	72.4	274.6	81.1	100.4	254.5	68.6	74.7	143.3
RADIUS = .700								
AMPLITUDE =	.0483	.0089	.0114	.0182	.0012	.0044	.0033	.0024
PHASE ANGLE =	73.7	244.3	81.9	97.7	255.8	64.1	107.9	57.8
RADIUS = .800								
AMPLITUDE =	.0340	.0063	.0116	.0205	.0020	.0032	.0041	.0041
PHASE ANGLE =	76.0	158.7	86.0	95.2	254.2	66.0	112.1	49.0
RADIUS = .900								
AMPLITUDE =	.0187	.0077	.0099	.0203	.0037	.0029	.0028	.0043
PHASE ANGLE =	76.5	106.8	96.0	94.7	250.9	80.4	104.3	66.9
RADIUS = 1.000								
AMPLITUDE =	.0086	.0084	.0062	.0188	.0052	.0033	.0013	.0043
PHASE ANGLE =	72.2	68.6	104.5	95.3	249.4	92.4	64.7	93.4

TABLE E-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 200 INC 4KTS13
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0019	.0085	.0078	.0120	.0016	.0058	.0004	.0057
PHASE ANGLE =	327.6	331.5	5.4	302.2	195.6	263.7	45.9	332.8
RADIUS = .350								
AMPLITUDE =	.0017	.0059	.0061	.0085	.0010	.0046	.0001	.0042
PHASE ANGLE =	344.1	334.6	6.6	301.9	208.3	266.6	229.8	334.5
RADIUS = .400								
AMPLITUDE =	.0017	.0030	.0042	.0047	.0005	.0033	.0007	.0024
PHASE ANGLE =	4.4	344.1	8.7	301.4	262.4	271.7	226.7	338.6
RADIUS = .500								
AMPLITUDE =	.0019	.0014	.0014	.0006	.0010	.0013	.0016	.0004
PHASE ANGLE =	31.3	108.4	20.9	120.3	339.2	292.0	225.5	92.7
RADIUS = .600								
AMPLITUDE =	.0020	.0026	.0005	.0026	.0012	.0004	.0020	.0017
PHASE ANGLE =	46.2	131.1	142.3	116.2	353.1	12.1	223.8	142.5
RADIUS = .700								
AMPLITUDE =	.0017	.0001	.0004	.0010	.0003	.0007	.0020	.0018
PHASE ANGLE =	61.7	14.6	213.3	359.7	20.6	149.8	223.5	156.9
RADIUS = .800								
AMPLITUDE =	.0011	.0019	.0001	.0028	.0008	.0011	.0012	.0013
PHASE ANGLE =	74.9	320.7	280.5	327.5	121.8	142.0	208.4	162.3
RADIUS = .900								
AMPLITUDE =	.0001	.0015	.0068	.0018	.0018	.0014	.0012	.0004
PHASE ANGLE =	181.0	327.3	72.6	340.1	102.8	78.2	100.8	105.1
RADIUS = 1.000								
AMPLITUDE =	.0010	.0004	.0018	.0012	.0027	.0026	.0029	.0011
PHASE ANGLE =	255.4	34.0	80.0	71.6	90.8	49.3	79.8	30.5

TABLE E-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 13

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 200 INC 4KTS13
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.4438	.0074	[illegible]	.0050	.0043	.0026	.0012	.0030
PHASE ANGLE =	181.9	150.6	185.5	183.2	20.9	207.7	184.0	175.0
RADIUS = .633								
AMPLITUDE =	.3919	.0104	.0073	.0024	.0019	.0006	.0026	.0002
PHASE ANGLE =	181.4	246.8	[illegible]	176.4	318.5	201.9	346.2	53.3
RADIUS = .781								
AMPLITUDE =	.3747	.0062	[illegible]	.0013	.0044	.0011	.0022	.0007
PHASE ANGLE =	180.8	99.9	[illegible]	323.2	11.4	158.1	12.1	44.3
RADIUS = .963								
AMPLITUDE =	.3649	.0081	.0021	.0013	.0041	.0018	.0005	.0006
PHASE ANGLE =	180.2	246.0	210.7	111.8	352.0	122.6	84.0	126.6

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0016	.0020	.0016	.0015	.0014	.0006	.0011	.0006
PHASE ANGLE =	147.9	189.9	176.9	209.2	142.3	166.1	174.4	145.1
RADIUS = .633								
AMPLITUDE =	.0015	.0007	.0009	.0005	.0010	.0011	.0010	.0010
PHASE ANGLE =	335.4	187.7	101.3	176.0	76.8	325.2	218.8	320.5
RADIUS = .781								
AMPLITUDE =	.0012	.0002	.0014	.0009	.0017	.0005	.0007	.0009
PHASE ANGLE =	352.5	281.2	265.1	151.4	275.0	225.2	250.3	226.6
RADIUS = .963								
AMPLITUDE =	.0005	.0009	[illegible]	.0009	.0004	.0005	.0006	.0005
PHASE ANGLE =	[illegible]	[illegible]	[illegible]	182.0	53.1	214.6	34.0	11.1

TABLE E-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 13

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 20D INC 4KTS13
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.5114	.0408	.0229	.0062	.0136	.0061	.0081	.0077
PHASE ANGLE =	182.2	100.5	178.4	197.4	36.6	201.6	166.8	173.7
RADIUS = .350								
AMPLITUDE =	.4913	.0292	.0201	.0059	.0105	.0050	.0059	.0063
PHASE ANGLE =	182.1	104.5	180.1	193.0	34.7	202.9	168.3	174.1
RADIUS = .400								
AMPLITUDE =	.4674	.0166	.0170	.0055	.0071	.0038	.0035	.0046
PHASE ANGLE =	182.0	114.8	182.6	187.9	30.5	205.0	171.7	174.5
RADIUS = .500								
AMPLITUDE =	.4277	.0067	.0118	.0045	.0026	.0019	.0004	.0020
PHASE ANGLE =	181.8	205.6	187.8	180.2	5.9	209.8	289.6	175.1
RADIUS = .600								
AMPLITUDE =	.3989	.0108	.0082	.0030	.0018	.0008	.0023	.0003
PHASE ANGLE =	181.5	244.5	191.1	176.2	319.9	209.3	342.9	159.3
RADIUS = .700								
AMPLITUDE =	.3831	.0022	.0065	.0006	.0031	.0008	.0025	.0005
PHASE ANGLE =	181.1	166.3	180.9	239.5	1.3	177.7	359.5	39.4
RADIUS = .800								
AMPLITUDE =	.3731	.0065	.0051	.0014	.0046	.0012	.0021	.0007
PHASE ANGLE =	180.8	98.8	172.6	328.1	11.7	154.1	14.8	46.9
RADIUS = .900								
AMPLITUDE =	.3669	.0023	.0032	.0008	.0047	.0015	.0011	.0006
PHASE ANGLE =	180.4	142.3	179.4	10.4	5.3	134.3	33.4	79.3
RADIUS = 1.000								
AMPLITUDE =	.3649	.0081	.0021	.0013	.0041	.0018	.0005	.0006
PHASE ANGLE =	180.2	246.0	210.7	111.8	352.0	122.6	84.0	126.6

TABLE E-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ALONE 20D INC 4KTS13
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0067	.0032	.0044	.0032	.0039	.0045	.0017	.0043
PHASE ANGLE =	147.8	195.4	213.4	209.7	211.9	158.6	135.7	154.4
RADIUS = .350								
AMPLITUDE =	.0051	.0029	.0034	.0026	.0028	.0032	.0014	.0031
PHASE ANGLE =	148.0	193.9	207.6	210.1	201.9	158.8	144.6	153.4
RADIUS = .400								
AMPLITUDE =	.0033	.0024	.0024	.0020	.0018	.0018	.0012	.0017
PHASE ANGLE =	148.1	192.0	196.5	210.2	179.8	159.9	158.0	151.3
RADIUS = .500								
AMPLITUDE =	.0005	.0016	.0013	.0011	.0014	.0002	.0010	.0001
PHASE ANGLE =	144.7	188.4	155.5	206.7	116.4	294.4	187.0	1.5
RADIUS = .600								
AMPLITUDE =	.0012	.0009	.0010	.0006	.0013	.0010	.0010	.0009
PHASE ANGLE =	334.7	185.7	110.9	187.5	85.1	326.6	211.8	325.9
RADIUS = .700								
AMPLITUDE =	.0014	.0003	.0001	.0008	.0007	.0005	.0009	.0007
PHASE ANGLE =	343.3	228.1	92.0	156.2	284.5	293.1	234.5	259.7
RADIUS = .800								
AMPLITUDE =	.0012	.0002	.0004	.0009	.0018	.0005	.0007	.0009
PHASE ANGLE =	354.8	284.0	284.9	151.8	274.7	217.4	254.5	223.6
RADIUS = .900								
AMPLITUDE =	.0008	.0003	.0001	.0009	.0011	.0006	.0003	.0004
PHASE ANGLE =	13.0	157.1	296.2	163.1	279.1	205.6	319.8	225.1
RADIUS = 1.000								
AMPLITUDE =	.0005	.0009	.0006	.0008	.0004	.0005	.0006	.0005
PHASE ANGLE =	41.5	149.2	99.9	182.0	53.1	214.6	34.0	11.1

APPENDIX F

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 14

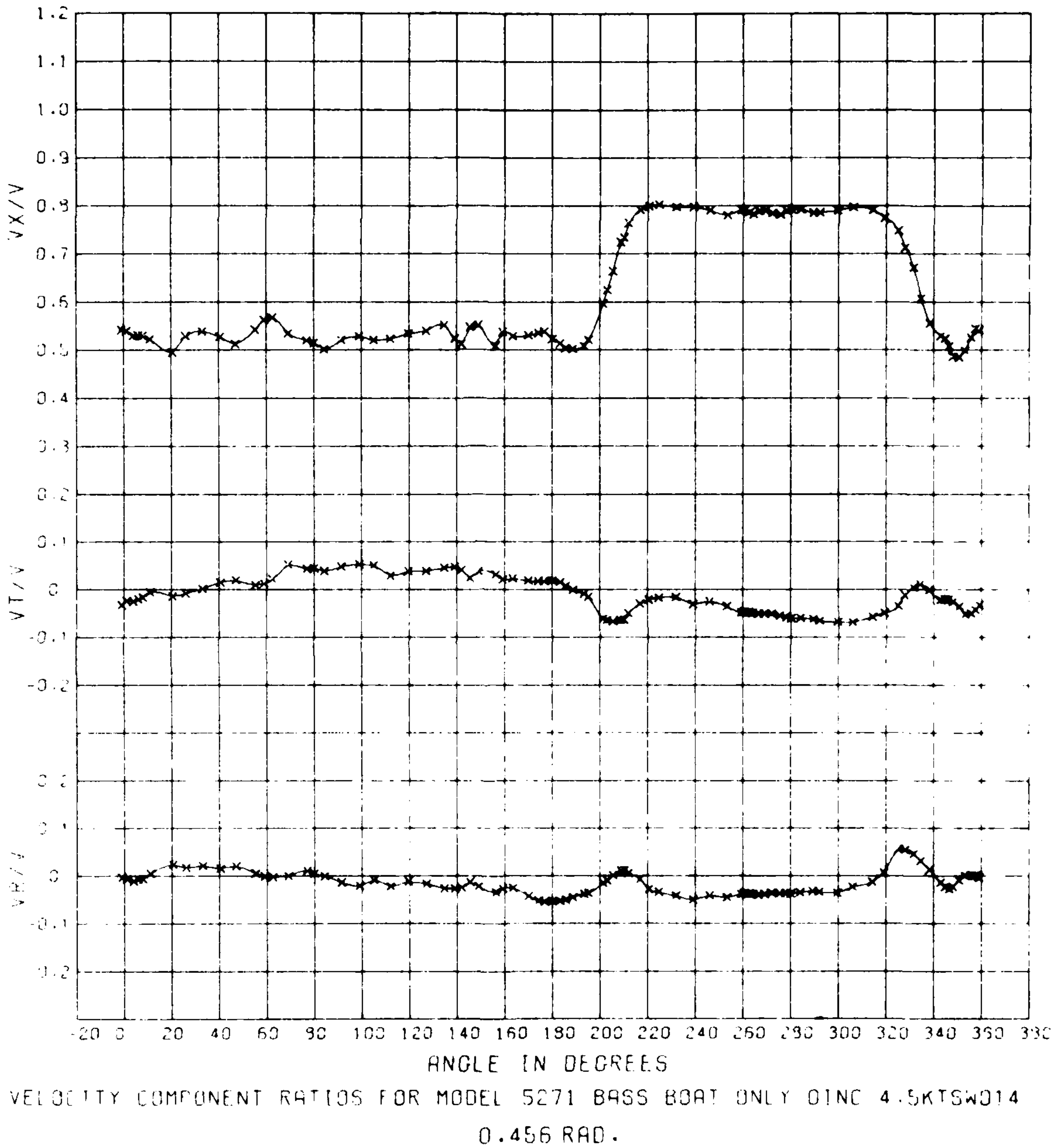

Figure F-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 14

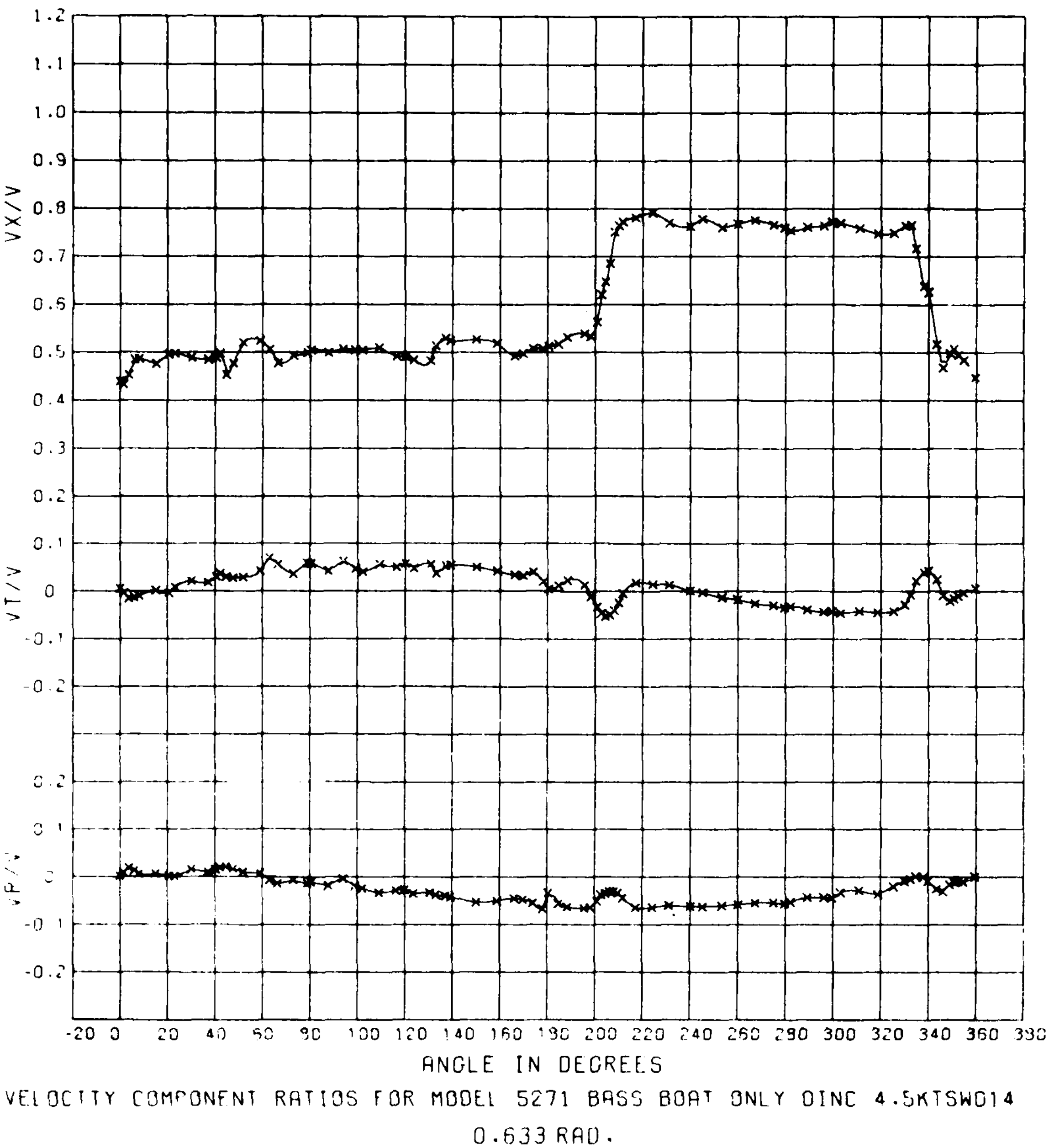

Figure F-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 14

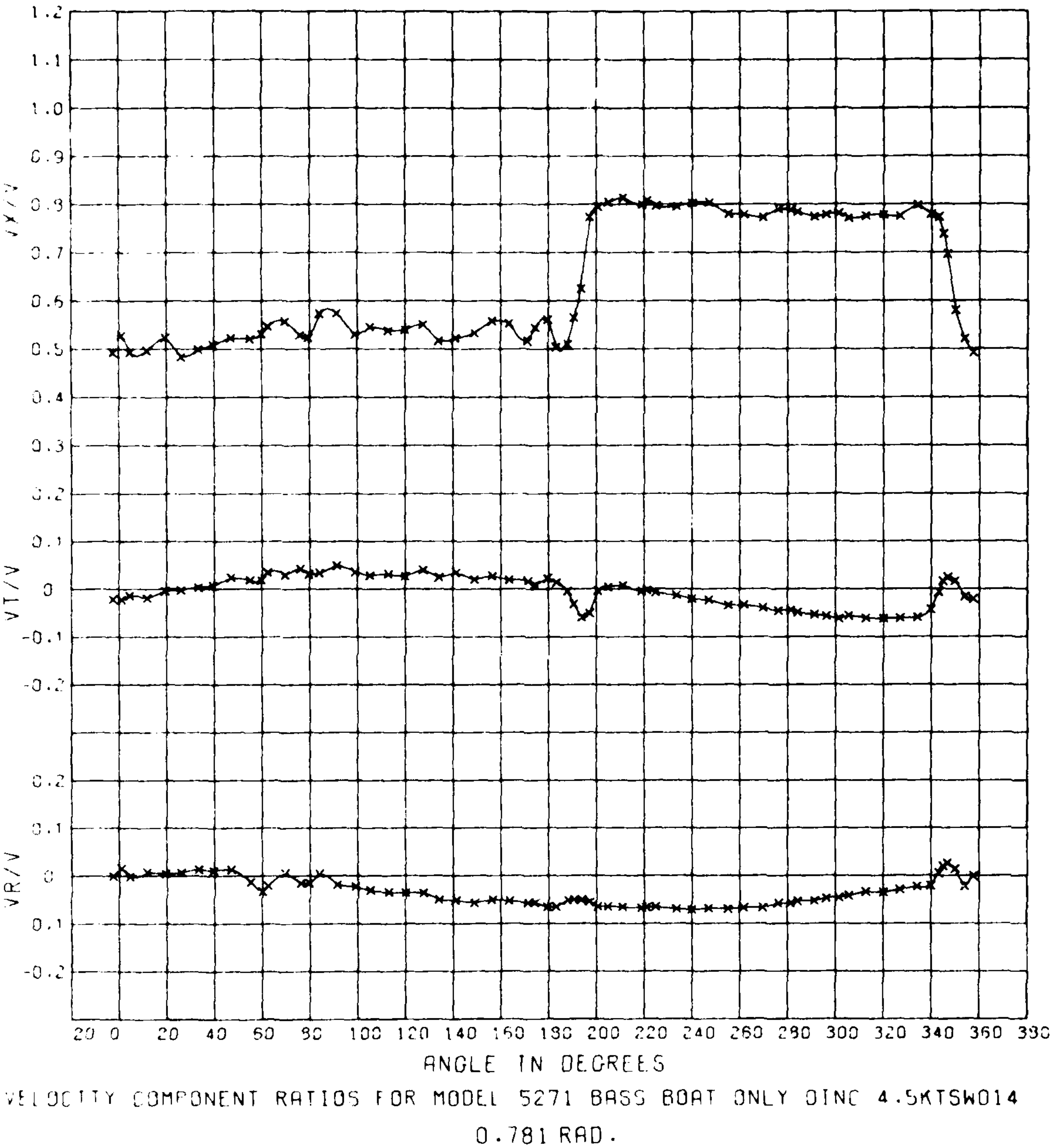

Figure F-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 14

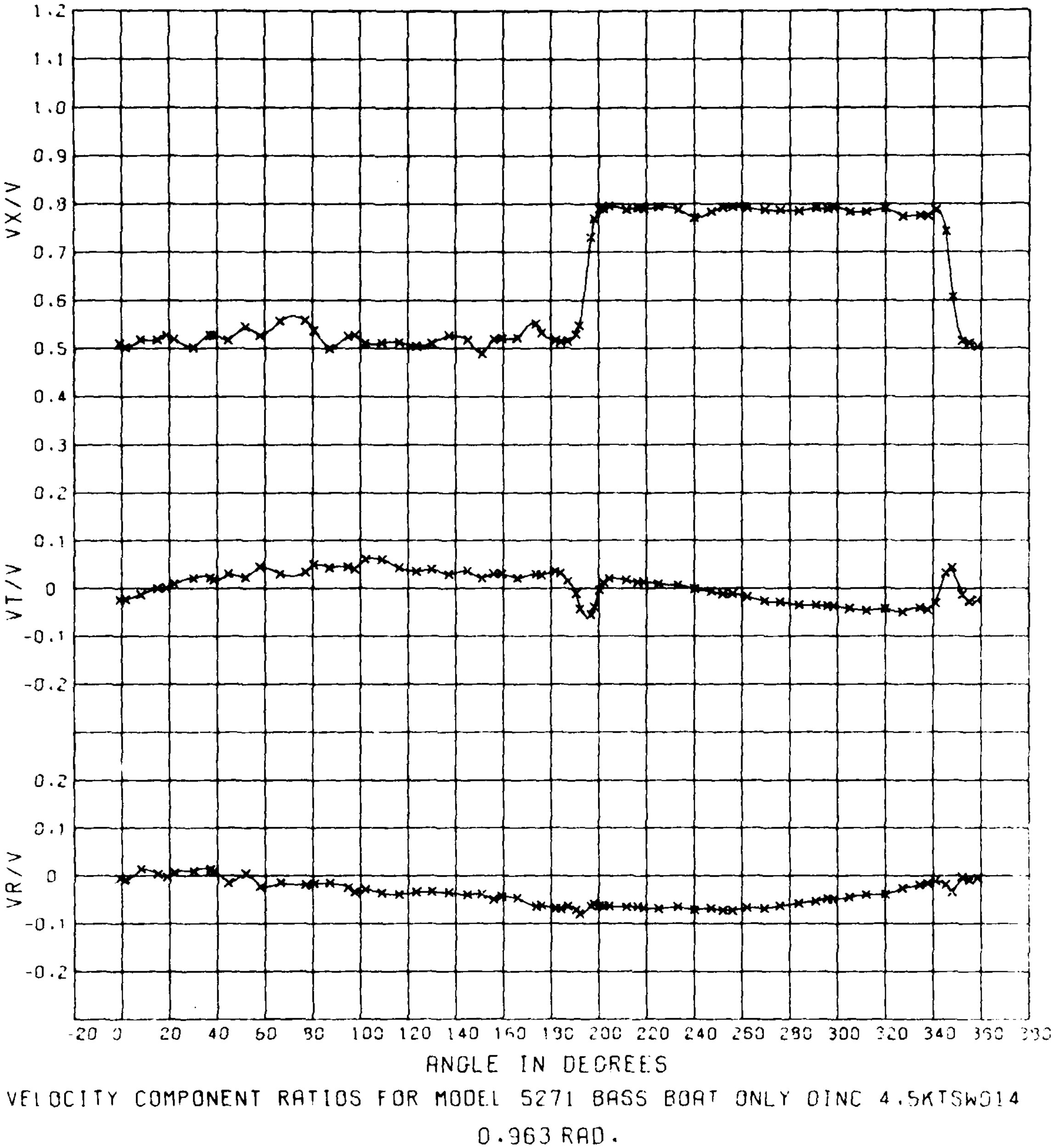

Figure F-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 14

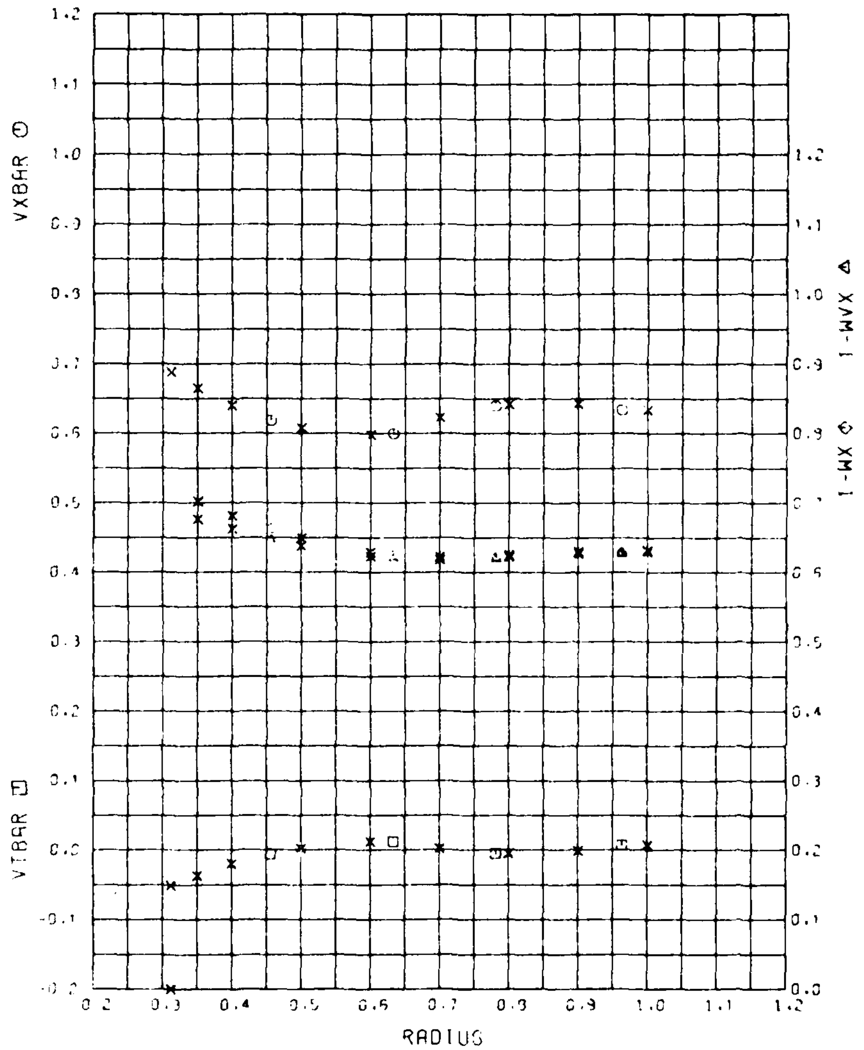

Figure F-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 14

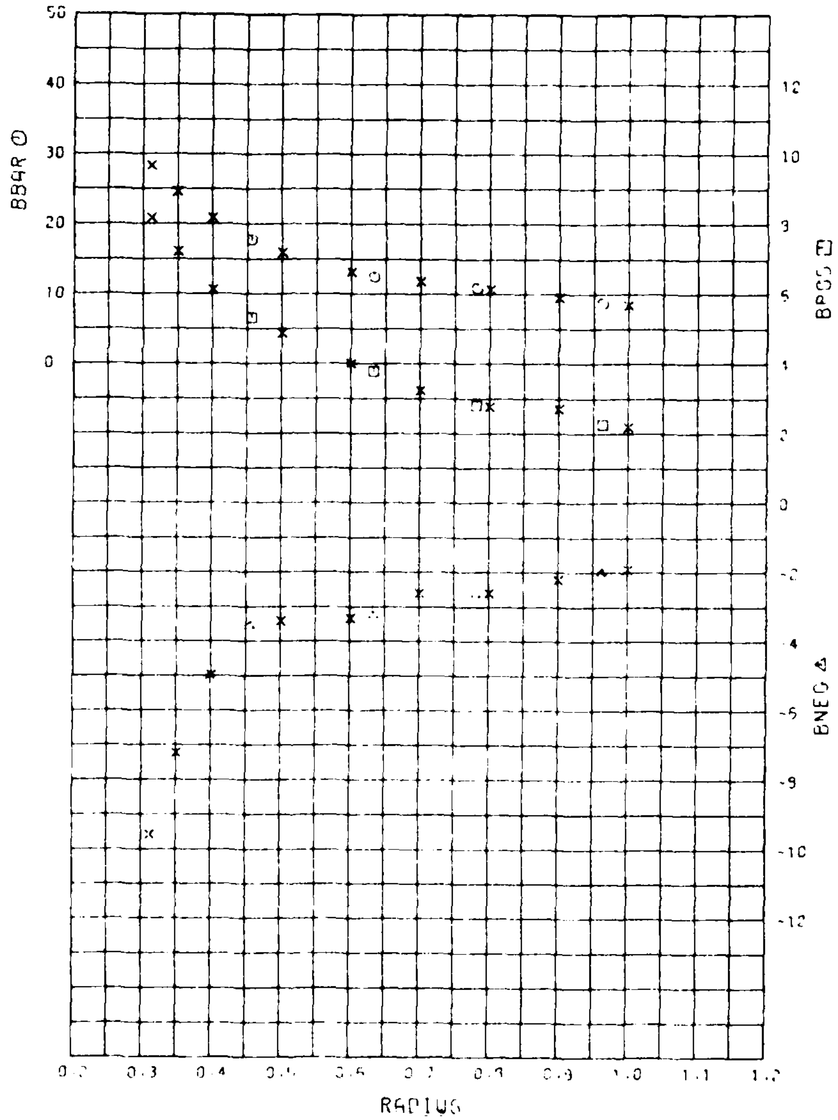

Figure F-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 14

TABLE F-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA
WITH BASS DYNAMOMETER BOAT, EXPERIMENT 14

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
1.0	.562	-.031	-.021
.0	.561	-.026	-.023
1.3	.562	-.026	-.003
4.0	.530	-.025	-.011
6.0	.531	-.020	-.007
7.4	.532	-.016	-.006
11.0	.522	-.006	.005
20.5	.495	-.014	.026
26.0	.529	-.009	.019
33.0	.519	.001	.022
40.0	.530	.014	.019
40.9	.526	.016	.017
47.0	.511	.020	.021
55.3	.561	.010	.005
59.0	.563	.013	-.001
62.5	.564	.022	-.003
69.0	.516	.053	-.000
76.9	.520	.061	.011
74.9	.514	.065	.005
86.2	.501	.079	-.000
91.4	.521	.069	-.014
99.0	.524	.053	-.021
105.0	.521	.051	-.049
112.0	.523	.029	-.022
119.6	.516	.039	-.012
127.0	.567	.039	-.017
134.6	.551	.044	-.026
[illegible]	.526	.044	-.027
141.9	.517	.041	-.025
145.6	.568	.026	-.013
149.0	.592	.039	-.022
156.2	.603	.032	-.033
159.1	.538	.021	-.026
163.6	.529	.026	-.025
170.0	.531	.019	-.043
174.2	.536	.018	-.052
176.1	.541	.016	-.052
177.0	.539	.019	-.055
180.0	.521	.019	-.053
181.3	.510	.016	-.053
183.3	.517	.016	-.052
185.0	.507	.010	-.052
186.0	.501	.004	-.049
188.6	.507	-.001	-.045
191.3	.508	-.009	-.038
195.1	.521	-.015	-.037
200.6	.573	-.057	-.021
202.0	.516	-.065	-.010
203.0	.625	-.066	-.010
204.9	.663	-.067	-.005
206.3	.686	-.064	.007
208.5	.719	-.065	.012
209.3	.731	-.066	.010
210.2	.733	-.063	.012
212.3	.766	-.049	.006
216.9	.791	-.030	-.007
220.3	.794	-.021	-.028
224.5	.802	-.019	-.036
231.9	.797	-.011	-.042
239.0	.798	-.031	-.050
246.0	.791	-.025	-.041
251.1	[illegible]	-.035	-.045
258.6	.793	-.044	-.017
259.4	.790	-.051	-.039
260.5	.757	-.046	-.037
262.3	.786	-.055	-.038
264.1	.787	-.049	-.039
265.9	.790	-.050	-.041
267.0	.787	-.050	-.040
269.3	.792	-.051	-.039
272.0	.786	-.051	-.036
274.9	.782	-.056	-.036
276.0	.780	-.056	-.038
278.0	.799	-.058	-.037
279.5	.791	-.063	-.034
280.1	.791	-.058	-.036
283.9	.793	-.068	-.035
289.2	.785	-.062	-.032
297.0	.786	-.066	-.034
299.3	.790	-.071	-.036
299.9	.790	-.065	-.035
306.0	.797	-.069	-.023
314.2	.792	-.057	-.013
319.1	.776	-.049	.007
325.1	.768	-.035	.057
328.0	.713	-.012	.055
331.6	.672	.004	.047
334.0	.626	.013	.036
335.0	.588	.011	.029
337.6	.559	.001	.016
338.9	.553	-.003	.011
342.9	.529	-.023	-.014
342.9	.517	-.021	-.014
344.0	.525	-.020	-.023
346.5	.509	-.019	-.027
348.0	.486	-.026	-.023
350.1	.479	-.030	-.016
351.0	.491	-.040	-.007
353.0	.499	-.052	.001
355.6	.526	-.049	.002
357.3	.545	-.042	.001
359.0	.567	-.031	-.001
360.0	.561	-.026	-.001

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
0.0	.440	.006	.002
1.5	.433	-.004	.000
3.3	.453	-.016	.018
4.0	.453	-.015	.021
6.0	.405	-.013	.013
8.0	.406	-.010	.006
15.0	.477	.001	.007
20.6	.496	-.004	.002
23.0	.498	.009	.001
30.0	.488	.022	.016
37.0	.485	.018	.010
40.3	.489	.031	.015
42.1	.498	.038	.019
44.6	.453	.031	.022
47.5	.477	.028	.017
51.8	.520	.030	.010
59.0	.526	.042	.006
63.0	.506	.070	-.008
66.3	.479	.056	-.013
73.0	.491	.036	-.006
79.0	.499	.059	-.013
80.5	.504	.058	-.011
87.0	.499	.042	-.018
96.0	.507	.063	-.004
99.0	.505	.067	-.019
107.1	.505	.061	-.026
109.2	.509	.057	-.033
116.3	.491	.050	-.029
120.0	.491	.058	-.027
123.5	.484	.048	-.035
130.6	.492	.057	-.033
133.0	.514	.038	-.038
137.0	.532	.056	-.040
139.1	.525	.055	-.042
150.0	.521	.051	-.051
150.0	.531	.042	-.049
159.6	.506	.043	-.052
166.0	.493	.036	-.045
169.6	.498	.032	-.047
173.0	.504	.041	-.054
178.0	.506	.028	-.067
180.0	.500	.012	-.059
180.0	.526	-.004	-.009
184.5	.517	.012	-.057
188.2	.532	.023	-.061
195.6	.539	.014	-.066
198.0	.531	-.011	-.064
200.0	.562	-.035	-.052
200.0	.565	-.031	-.051
202.5	.621	-.046	-.037
204.6	.668	-.052	-.035
206.2	.685	-.050	-.031
208.0	.751	-.040	-.031
209.0	.765	-.026	-.036
211.5	.772	-.006	-.044
217.0	.781	.019	-.064
226.1	.792	.015	-.064
231.0	.770	.014	-.060
239.0	.763	.001	-.062
245.0	.779	-.001	-.063
253.1	.760	-.013	-.060
259.6	.767	-.018	-.059
260.0	.767	-.018	-.059
267.0	.775	-.026	-.055
274.0	.766	-.038	-.056
279.6	.763	-.036	-.056
282.0	.753	-.031	-.053
289.0	.761	-.039	-.043
296.0	.766	-.043	-.043
299.6	.772	-.042	-.044
303.0	.769	-.046	-.033
310.9	.759	-.041	-.020
318.1	.766	-.043	-.037
319.2	.767	-.047	-.037
325.3	.768	-.042	-.020
330.0	.763	-.029	-.010
332.5	.765	-.000	-.005
334.3	.733	.013	.000
335.0	.702	.032	.007
338.0	.660	.040	-.000
339.0	.627	.043	-.009
343.6	.517	.025	-.026
346.0	.469	-.010	-.031
348.9	.499	-.021	-.016
350.6	.508	-.016	-.010
352.6	.496	-.010	-.009
356.2	.492	-.006	-.011
355.0	.476	-.002	-.012
359.0	.455	.006	-.001
360.0	.467	.006	.002

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-2.6	.492	-.027	-.001
1.0	.520	-.022	-.016
4.5	.497	-.016	-.007
11.0	.497	-.010	.008
19.0	.521	-.007	.004
20.2	.526	-.002	.004
26.1	.483	-.002	.007
33.4	.496	.003	.016
39.0	.506	.007	.009
40.0	.510	.006	.013
47.0	.523	.026	.016
54.0	.521	.019	-.013
59.0	.531	.019	-.033
62.2	.547	.035	-.021
69.5	.557	.038	.006
76.0	.579	.043	-.015
79.6	.523	.031	-.015
83.9	.574	.036	.005
91.2	.532	.035	-.019
98.4	.527	.036	-.023
99.4	.544	.029	-.023
105.0	.534	.032	-.038
112.0	.530	.028	-.035
119.4	.543	.026	-.036
120.1	.551	.026	-.037
127.3	.516	.040	-.036
134.0	.522	.035	-.050
141.0	.536	.021	-.051
144.9	.556	.027	-.057
156.2	.556	.020	-.050
163.4	.520	.022	-.052
170.6	.513	.011	-.050
172.0	.532	.008	-.056
174.2	.558	.011	-.058
179.0	.576	.021	-.058
180.0	.567	.025	-.064
183.3	.506	.016	-.065
188.0	.510	-.006	-.052
190.5	.565	-.031	-.058
193.0	.607	-.071	-.051
194.0	.771	-.051	-.051
197.0	.794	-.006	-.055
200.6	.805	-.005	-.065
204.0	.814	.007	-.066
211.0	.902	-.002	-.066
219.0	[illegible]	[illegible]	-.067
221.0	.888	-.002	-.066
224.0	.797	-.007	-.065
233.6	.796	-.013	-.069
240.0	.802	-.021	-.071
247.0	.806	-.023	-.068
255.1	.779	-.035	-.069
261.0	.787	-.033	-.060
262.4	.775	-.033	-.067
269.6	.772	-.040	-.067
276.0	.790	-.045	-.058
281.2	.789	-.046	-.058
283.9	.784	-.049	-.054
291.0	.776	-.053	-.051
296.0	.778	-.057	-.047
301.1	.780	-.061	-.046
305.3	.771	-.056	-.042
312.5	.775	-.061	-.036
319.6	.778	-.063	-.035
320.0	.777	-.061	-.035
326.0	.775	-.061	-.030
334.0	.798	-.059	-.023
339.6	.777	-.046	-.021
340.0	.781	-.040	-.021
343.0	.773	-.007	.005
344.0	.738	.017	.021
346.6	.697	.025	.027
349.0	.500	.017	.014
353.0	.521	-.017	-.023
357.6	.492	-.022	-.001
361.0	.520	-.022	.014

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-1.0	.509	-.023	-.006
1.6	.503	-.023	-.010
6.0	.510	-.013	.015
15.0	.517	-.000	.006
18.0	.520	.001	-.003
22.0	.519	.018	.007
30.0	.501	.022	.010
37.0	.520	.023	.013
38.5	.527	.017	.009
44.0	.517	.031	-.016
51.0	.565	.023	.006
58.0	.526	.045	-.023
66.3	.557	.038	-.015
77.0	.558	.036	-.019
80.5	.536	.050	-.016
87.0	.499	.042	-.016
94.0	.525	.046	-.025
97.0	.528	.041	-.035
102.1	.509	.061	-.029
109.0	.512	.060	-.036
116.3	.513	.043	-.039
123.5	.506	.036	-.033
130.0	.511	.044	-.034
137.0	.51	.032	-.037
137.2	.526	.027	-.040
145.0	.517	.037	-.038
151.0	.488	.021	-.049
156.0	.519	.031	-.044
159.6	.521	.036	-.046
166.0	.521	.021	-.062
173.0	.552	.030	-.064
176.0	.532	.032	-.064
182.0	.537	.036	-.063
186.0	.516	.016	-.066
187.0	.515	.002	-.076
190.0	.532	-.023	-.080
191.0	.528	-.042	-.066
192.0	.568	-.050	-.058
196.0	.722	-.053	-.063
197.2	.739	-.030	-.064
198.0	.764	-.003	-.063
200.2	.769	.013	-.066
202.0	.790	.020	-.066
204.6	.796	.010	-.067
211.0	.780	.012	-.065
216.0	.792	.016	[illegible]
218.0	.790	[illegible]	[illegible]
225.0	.795	.009	-.060
233.2	.789	.007	-.065
240.0	.770	-.001	-.071
247.0	.783	-.006	-.068
252.0	.793	-.012	-.072
256.0	.796	-.011	-.072
262.1	.792	-.017	-.068
269.4	.787	-.027	-.068
276.0	.787	-.020	-.063
283.0	.785	-.036	-.058
291.0	.791	-.035	-.053
295.0	.789	-.036	-.049
298.3	.793	-.037	-.049
305.0	.786	-.041	-.045
312.0	.783	-.046	-.039
319.9	.790	-.043	-.039
327.1	.776	-.049	-.027
334.6	.775	-.040	-.020
337.0	.774	-.045	-.017
338.0	.777	-.044	-.016
341.0	.787	-.036	-.011
345.2	.743	.033	-.010
348.0	.609	.043	-.035
352.0	.515	-.016	-.003
355.0	.511	-.020	-.009
356.0	.500	-.029	-.005
359.0	.509	-.023	-.006
361.4	.503	-.023	-.010

TABLE F-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 14

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY OINC 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.619	.600	.640	.634	.688	.665	.640	.608	.598	.623	.642	.643	.634
VTBAR =	-.006	.012	-.005	.007	-.051	-.037	-.020	.002	.012	.002	-.005	-.001	.007
VRBAR =	-.014	-.030	-.035	-.037	.007	.000	-.007	-.019	-.028	-.033	-.035	-.037	-.037
1-WVX =	.647	.620	.619	.627	0.000	.676	.662	.638	.623	.618	.622	.627	.630
1-WX =	.663	.625	.622	.629	0.000	.702	.6[illegible]1	.649	.629	.622	.625	.630	.632
BBAR =	17.76	12.51	10.92	8.78	28.34	24.62	20.[illegible]5	[illegible]	13.13	11.81	10.70	9.53	8.46
BPOS =	5.32	3.77	2.81	2.27	8.17	7.21	6.12	4.87	4.00	3.23	2.77	2.71	2.19
THETA =	307.50	222.50	210.00	300.00	282.50	282.50	282.50	[illegible]	300.00	222.50	335.00	200.00	300.00
BNEG =	-3.55	-3.25	-2.64	-2.00	-9.59	-7.24	-4.[illegible]7	-3.41	-3.33	-2.61	-2.61	-2.21	-1.92
THETA =	350.00	0.00	27.50	150.00	187.50	187.50	187.50	347.50	0.00	357.50	27.50	27.50	150.00

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE I-3 – HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 14

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY DING 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .7[illegible]

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.1470	.0684	.0047	.0445	.0203	.0042	.0230	.0086
PHASE ANGLE =	182.7	273.5	169.0	272.3	18.0	269.3	10.2	104.0
RADIUS = .633								
AMPLITUDE =	.1568	.0596	.0247	.0430	.0109	.0226	.0161	.0052
PHASE ANGLE =	184.1	269.0	187.8	243.0	357.6	263.7	354.9	341.9
RADIUS = .781								
AMPLITUDE =	.1554	.0438	.0520	.0318	.0124	.0280	.0020	.0225
PHASE ANGLE =	184.2	268.5	178.2	255.4	160.8	257.8	359.5	261.9
RADIUS = .963								
AMPLITUDE =	.1627	.0428	.0438	.0342	.0139	.0249	.0068	.0206
PHASE ANGLE =	179.2	276.1	188.0	259.0	161.1	267.1	344.4	253.0

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0069	.0123	.0046	.0097	.0013	.0026	.0006	.0022
PHASE ANGLE =	.4	120.8	96.2	74.9	332.1	44.2	266.5	254.1
RADIUS = .633								
AMPLITUDE =	.0157	.0077	.0041	.0109	.0079	.0050	.0043	.0022
PHASE ANGLE =	312.2	58.2	301.3	82.2	127.6	41.3	180.9	224.3
RADIUS = .781								
AMPLITUDE =	.0116	.0148	.0042	.0016	.0119	.0030	.0066	.0095
PHASE ANGLE =	7.1	258.8	331.9	313.1	338.2	180.5	320.7	111.4
RADIUS = .963								
AMPLITUDE =	.0110	.0096	.0160	.0097	.0122	.0023	.0086	.0073
PHASE ANGLE =	336.1	247.1	355.5	256.1	339.5	151.4	350.8	48.3

TABLE F-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 14

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY OINC 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.1301	.0683	.0114	.0375	.0243	.0205	.0244	.0219
PHASE ANGLE =	180.1	280.7	143.9	286.4	62.6	88.5	36.0	167.7
RADIUS = .350								
AMPLITUDE =	.1354	.0689	.0083	.0399	.0222	.0131	.0239	.0165
PHASE ANGLE =	180.9	278.4	150.0	281.6	48.7	87.8	27.7	156.2
RADIUS = .400								
AMPLITUDE =	.1414	.0691	.0061	.0425	.0210	.0043	.0236	.0115
PHASE ANGLE =	181.9	275.9	167.5	276.6	32.2	85.7	18.4	134.9
RADIUS = .500								
AMPLITUDE =	.1506	.0673	.0049	.0453	.0194	.0100	.0221	.0075
PHASE ANGLE =	183.2	272.0	195.1	269.6	10.0	267.3	5.1	79.4
RADIUS = .600								
AMPLITUDE =	.1559	.0621	.0183	.0442	.0140	.0202	.0182	.0053
PHASE ANGLE =	183.9	269.6	190.5	264.5	359.1	264.7	356.8	16.0
RADIUS = .700								
AMPLITUDE =	.1554	.0508	.0379	.0364	.0027	.0259	.0077	.0135
PHASE ANGLE =	184.6	268.2	179.6	259.0	129.8	259.2	356.5	272.7
RADIUS = .800								
AMPLITUDE =	.1556	.0427	.0534	.0312	.0139	.0282	.0014	.0237
PHASE ANGLE =	183.9	268.9	178.4	255.0	161.7	257.9	359.1	260.7
RADIUS = .900								
AMPLITUDE =	.1589	.0407	.0520	.0314	.0167	.0271	.0024	.0248
PHASE ANGLE =	181.5	272.6	181.9	255.9	162.6	261.6	341.4	256.1
RADIUS = 1.000								
AMPLITUDE =	.1627	.428	.0438	.0342	.0139	.0249	.0068	.0206
PHASE ANGLE =	179.2	276.1	188.0	259.0	161.1	267.1	344.4	253.0

TABLE F-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY DINC 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0315	.0306	.0167	.0059	.0342	.0086	.0169	.0071
PHASE ANGLE =	86.2	183.3	86.3	311.2	319.8	206.3	341.3	96.5
RADIUS = .350								
AMPLITUDE =	.0215	.0231	[illegible]	[illegible]	.0233	.0049	.0114	.0039
PHASE ANGLE =	80.6	172.3	[illegible]	5.2	319.8	203.3	340.6	99.9
RADIUS = .400								
AMPLITUDE =	.0112	.0163	[illegible]	.0061	.0114	.0010	.0053	.0007
PHASE ANGLE =	62.1	151.2	91.8	60.7	320.2	173.6	337.7	141.8
RADIUS = .500								
AMPLITUDE =	.0098	.0122	[illegible]	.0115	.0042	.0044	.0027	.0032
PHASE ANGLE =	325.1	[illegible]	[illegible]	79.0	132.8	39.3	178.0	257.4
RADIUS = .600								
AMPLITUDE =	.0154	.0098	[illegible]	.0119	.0086	.0055	.0048	.0029
PHASE ANGLE =	310.7	[illegible]	[illegible]	82.2	131.1	39.4	176.6	243.8
RADIUS = .700								
AMPLITUDE =	.0118	.0059	[illegible]	.0050	.0041	.0013	.0027	.0057
PHASE ANGLE =	341.6	272.1	[illegible]	[illegible]	3.3	95.2	284.8	126.2
RADIUS = .800								
AMPLITUDE =	.0117	.0159	[illegible]	.0025	.0131	.0034	.0073	[illegible]
PHASE ANGLE =	9.6	257.8	334.7	290.8	337.2	183.1	323.9	108.6
RADIUS = .900								
AMPLITUDE =	.0109	.0154	.0135	.0074	.0149	.0035	.0090	.0087
PHASE ANGLE =	1.6	253.4	347.9	264.1	336.4	179.2	338.2	85.7
RADIUS = 1.000								
AMPLITUDE =	.0110	.0096	.0160	.0097	.0122	.0023	.0086	.0073
PHASE ANGLE =	336.1	247.1	359.5	256.1	339.5	151.4	350.8	48.3

TABLE F-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 14

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY OINC 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0494	.0044	.0044	.0126	.0061	.0026	.0096	.0045
PHASE ANGLE =	345.3	216.3	92.4	176.6	293.6	208.5	268.1	17.3
RADIUS = .633								
AMPLITUDE =	.0425	.0032	[illegible]	.0113	.0007	.0067	.0071	.0005
PHASE ANGLE =	340.2	314.2	83.9	185.9	165.5	171.9	255.3	235.3
RADIUS = .781								
AMPLITUDE =	.0428	.0074	.0058	.0056	.0054	.0060	.0005	.0068
PHASE ANGLE =	338.5	343.3	81.9	159.1	84.0	173.6	190.4	161.1
RADIUS = .963								
AMPLITUDE =	.0388	.0093	[illegible]	.0021	.0020	.0083	.0007	.0056
PHASE ANGLE =	335.6	328.1	82.0	160.1	350.7	175.7	288.2	175.2

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0043	.0057	.0024	.0065	.0005	.0011	.0019	.0010
PHASE ANGLE =	278.4	18.1	23.6	338.1	163.0	192.3	69.1	128.9
RADIUS = .633								
AMPLITUDE =	.0062	.0042	.0015	.0057	.0047	.0031	.0057	.0022
PHASE ANGLE =	240.4	342.5	193.8	350.2	50.8	314.9	76.8	172.5
RADIUS = .781								
AMPLITUDE =	.0028	.0049	.0047	.0010	.0062	.0003	.0035	.0034
PHASE ANGLE =	268.6	178.7	[illegible]	142.1	260.1	48.1	239.7	13.9
RADIUS = .963								
AMPLITUDE =	.0057	.0049	[illegible]	[illegible]	.0048	.0038	.0070	.0026
PHASE ANGLE =	262.4	161.8	[illegible]	[illegible]	256.2	12.5	262.5	338.6

TABLE F-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 14

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY CINC 4.5KTSWC14
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0612	.0087	.0017	.0113	.0133	.0074	.0083	.0090
PHASE ANGLE =	349.9	200.5	201.7	142.6	311.2	317.8	293.5	48.7
RADIUS = .350								
AMPLITUDE =	.0575	.0076	.0015	.0114	.0111	.0049	.0087	.0076
PHASE ANGLE =	348.8	202.8	140.1	154.8	307.3	309.0	284.1	41.2
RADIUS = .400								
AMPLITUDE =	.0533	.0060	.0028	.0119	.0086	.0025	.0093	.0060
PHASE ANGLE =	347.2	207.3	103.3	167.2	301.5	277.4	275.1	30.3
RADIUS = .500								
AMPLITUDE =	.0469	.0033	.0054	.0128	.0044	.0039	.0095	.0035
PHASE ANGLE =	343.9	229.6	88.6	161.4	285.9	186.3	264.0	6.7
RADIUS = .600								
AMPLITUDE =	.0431	.0026	.0047	.0120	.0011	.0063	.0080	.0009
PHASE ANGLE =	341.0	295.8	84.6	186.1	242.9	173.2	257.2	327.3
RADIUS = .700								
AMPLITUDE =	.0430	.0053	.0043	.0042	.0036	.0061	.0032	.0040
PHASE ANGLE =	339.5	336.4	82.4	174.3	91.7	172.5	249.4	162.5
RADIUS = .800								
AMPLITUDE =	.0426	.0078	.0057	.0052	.0055	.0061	.0005	.0071
PHASE ANGLE =	338.3	343.1	81.8	155.9	82.4	173.9	140.0	161.4
RADIUS = .900								
AMPLITUDE =	.0407	.0090	.0057	.0030	.0035	.0071	.0007	.0071
PHASE ANGLE =	336.8	336.6	81.6	151.9	64.3	175.2	82.5	166.3
RADIUS = 1.000								
AMPLITUDE =	.0388	.0093	.0059	.0021	.0020	.0083	.0007	.0056
PHASE ANGLE =	335.6	328.1	82.0	180.1	350.7	175.7	288.2	175.2

TABLE F-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY OINC 4.5KTSW014
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0095	.0081	.0062	.0034	.0178	.0099	.0130	.0074
PHASE ANGLE =	.3	96.5	357.7	281.6	236.1	147.9	255.2	17.0
RADIUS = .350								
AMPLITUDE =	.0068	.0062	.0063	.0040	.0119	.0070	.0081	.0048
PHASE ANGLE =	348.2	76.9	2.8	310.0	235.0	150.2	255.9	21.1
RADIUS = .400								
AMPLITUDE =	.0045	.0053	.0042	.0054	.0056	.0038	.0027	.0021
PHASE ANGLE =	319.5	45.4	12.2	328.6	231.7	156.8	258.9	36.6
RADIUS = .500								
AMPLITUDE =	.0051	.0060	.0014	.0070	.0028	.0013	.0043	.0019
PHASE ANGLE =	258.3	5.1	55.5	342.5	64.6	283.2	72.9	163.2
RADIUS = .600								
AMPLITUDE =	.0063	.0052	.0012	.0064	.0052	.0030	.0062	.0026
PHASE ANGLE =	241.7	347.8	[illegible]	348.5	54.6	312.5	75.6	173.6
RADIUS = .700								
AMPLITUDE =	.0039	.0012	.0029	.0022	.0021	.0012	.0012	.0012
PHASE ANGLE =	250.4	211.5	243.2	[illegible]	289.6	310.7	116.7	36.9
RADIUS = .800								
AMPLITUDE =	.0028	.0054	.0050	.0015	.0017	.0005	.0043	.0037
PHASE ANGLE =	271.7	177.1	257.3	150.1	258.7	57.4	243.1	11.9
RADIUS = .900								
AMPLITUDE =	.0039	.0062	.0060	.0030	.0070	.0020	.0067	.0037
PHASE ANGLE =	270.5	170.1	261.0	156.8	255.8	27.6	254.3	359.3
RADIUS = 1.000								
AMPLITUDE =	.0057	.0049	.0060	.0029	.0048	.0038	.0070	.0026
PHASE ANGLE =	262.4	161.8	261.7	154.9	256.2	12.5	262.5	338.6

APPENDIX G

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS FOR EXPERIMENT 15

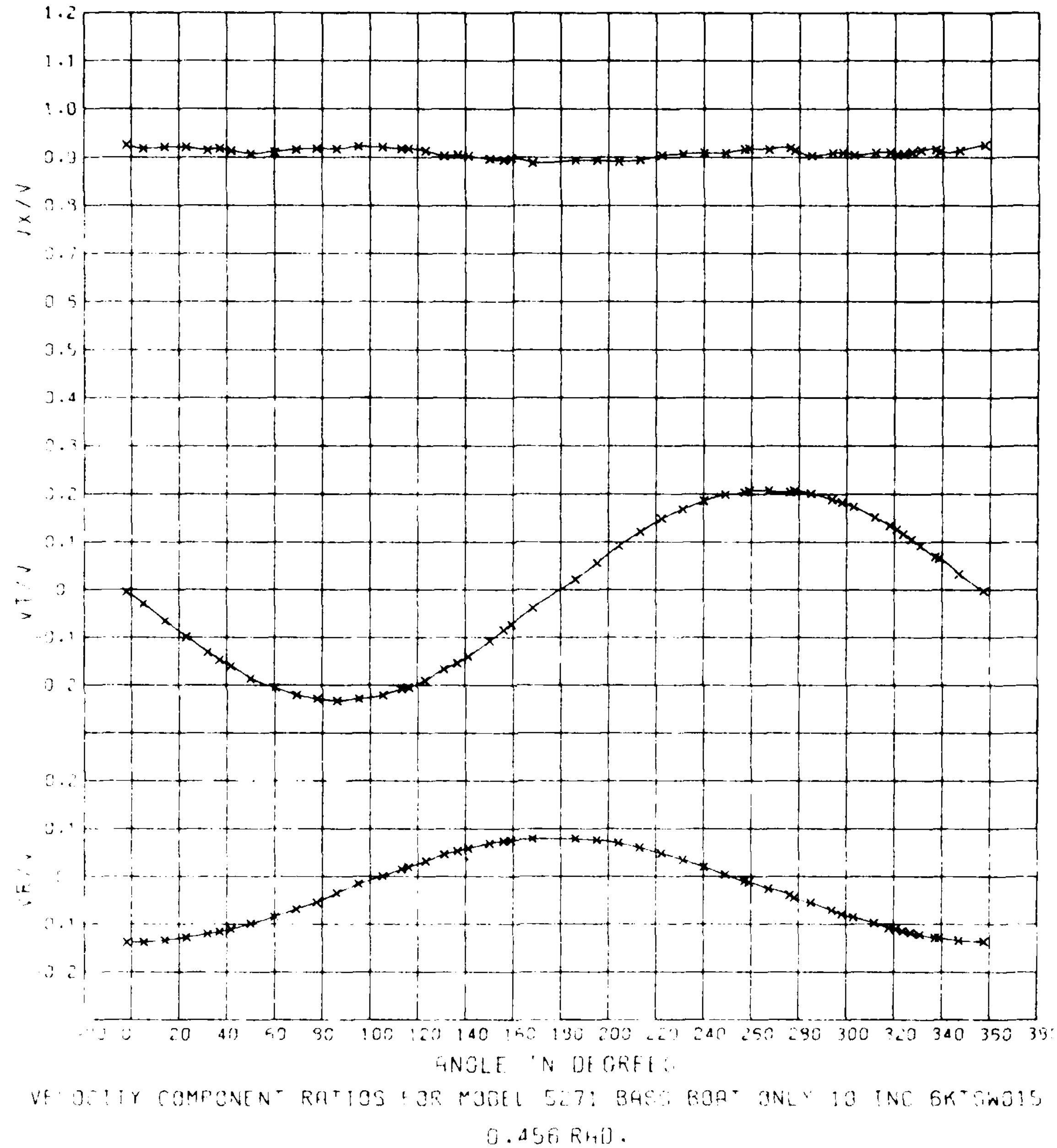

Figure G-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 15

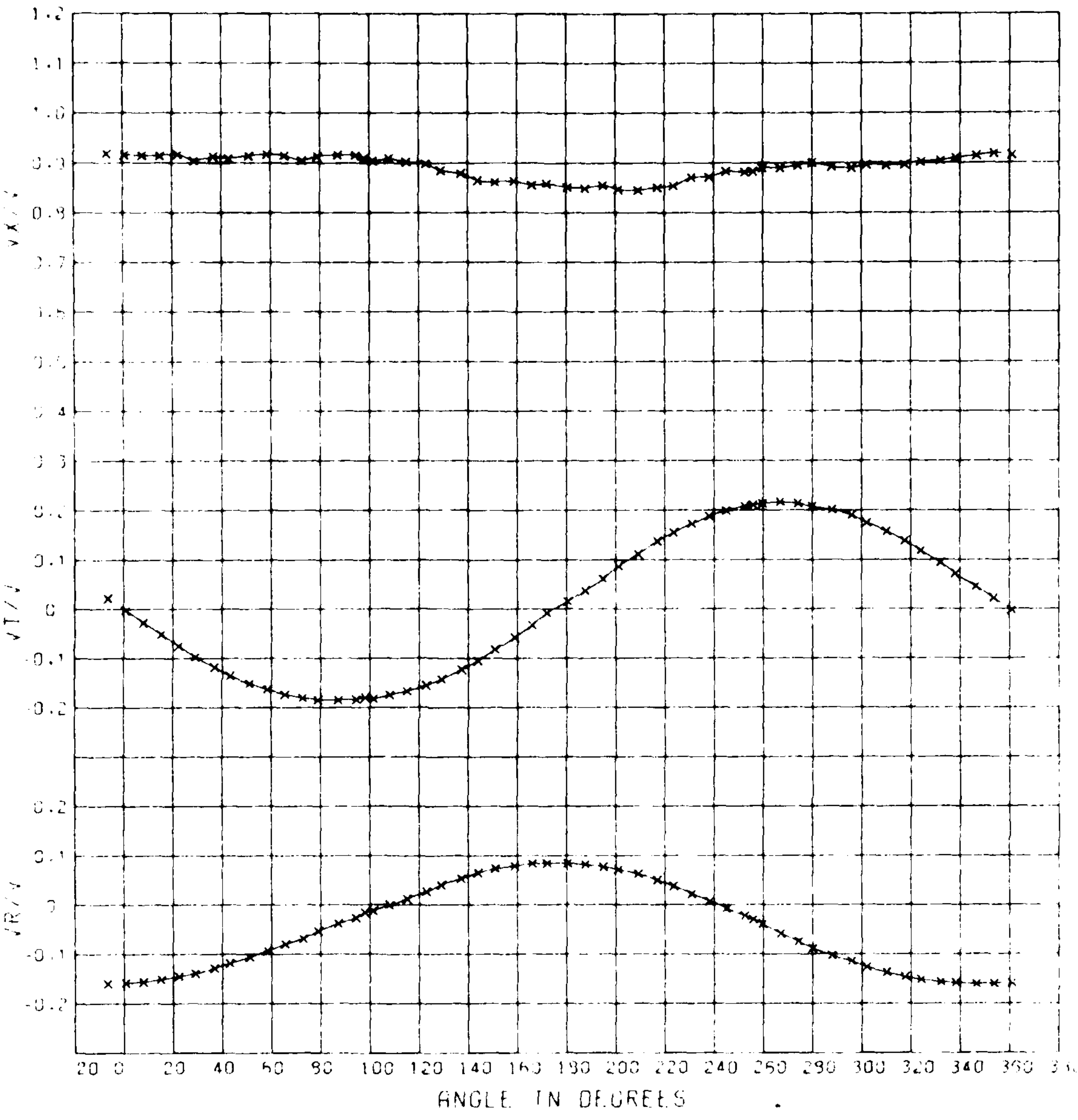

Figure G-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 15

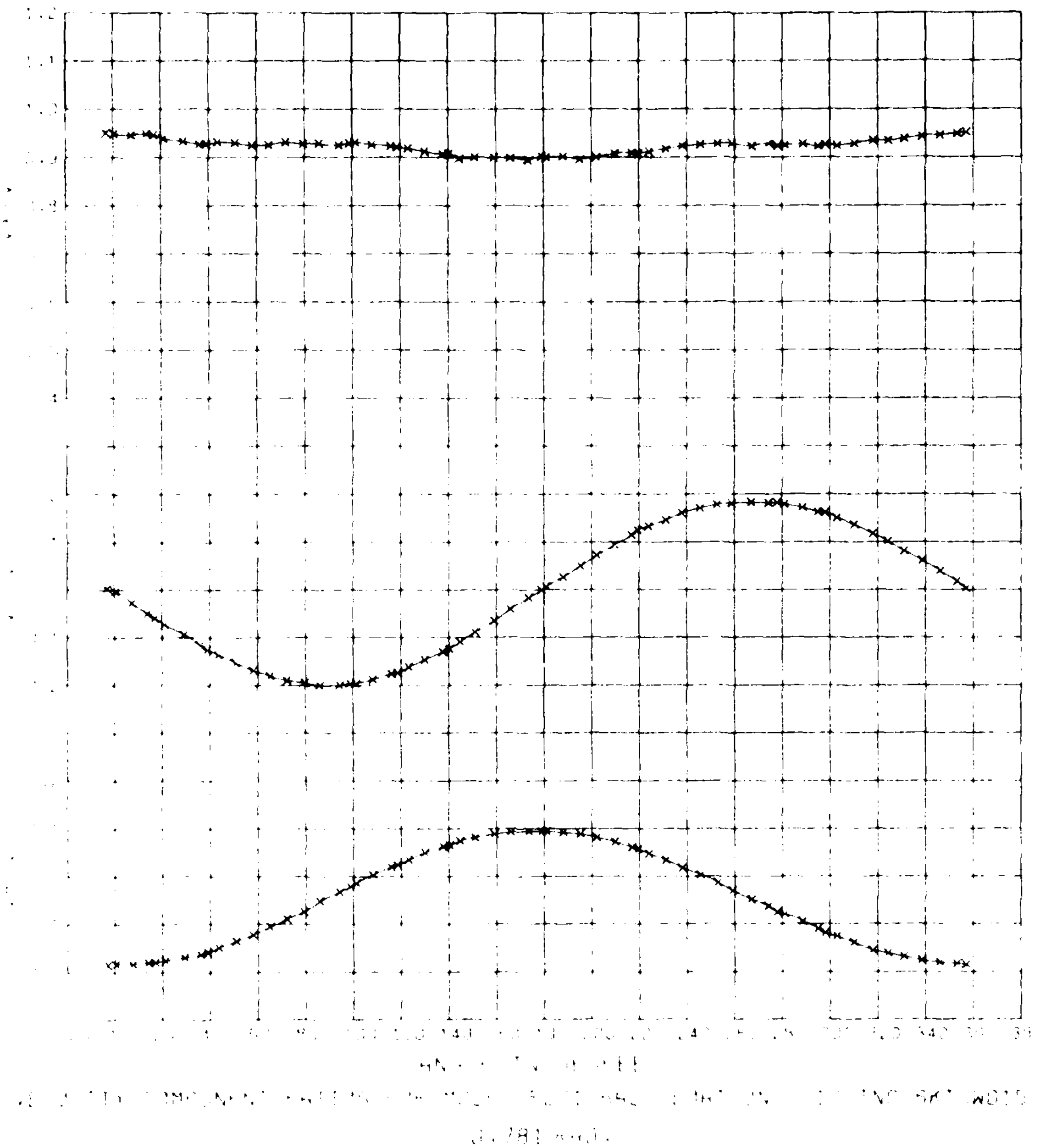

Figure G-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 15

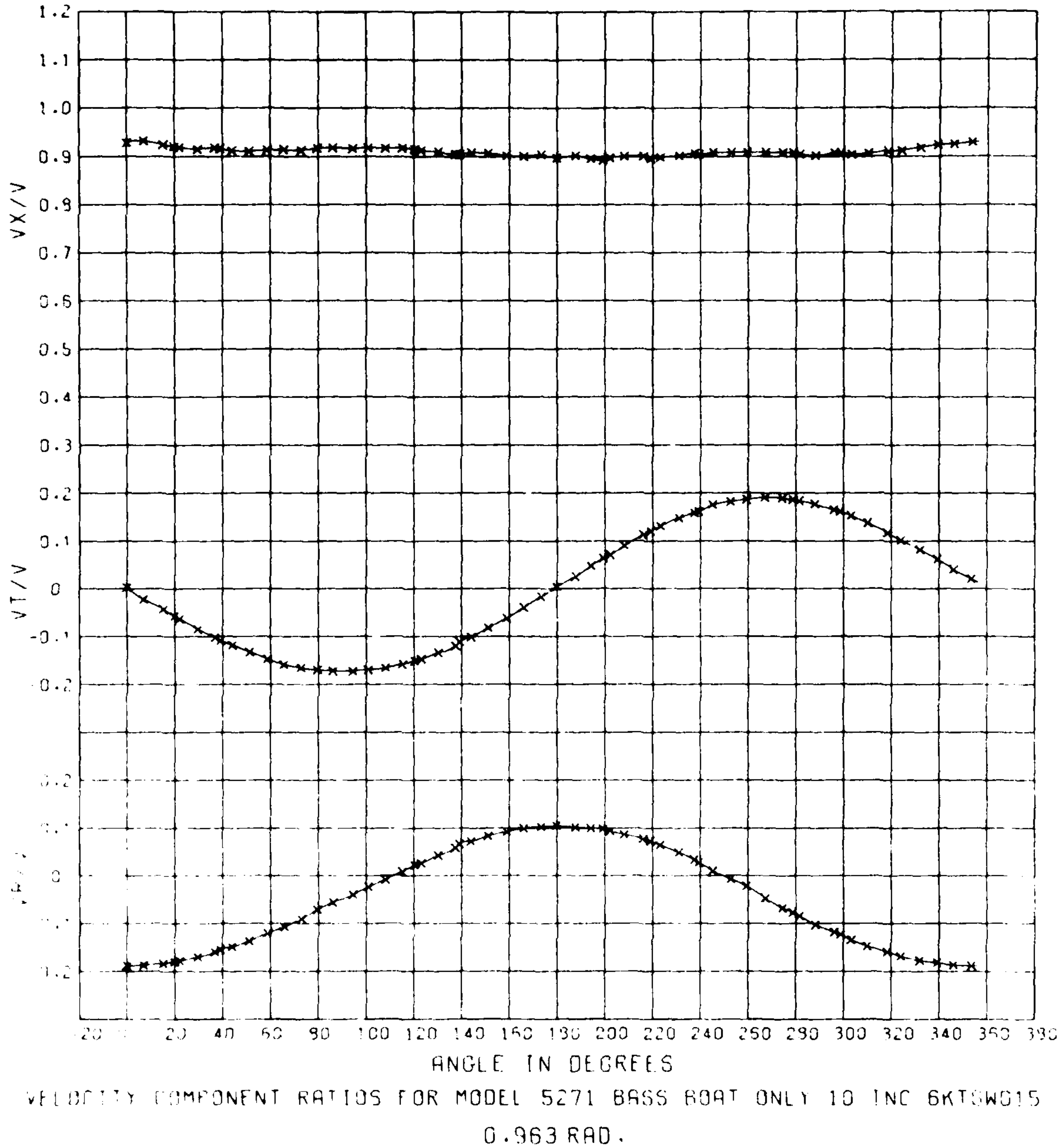

Figure G-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 15

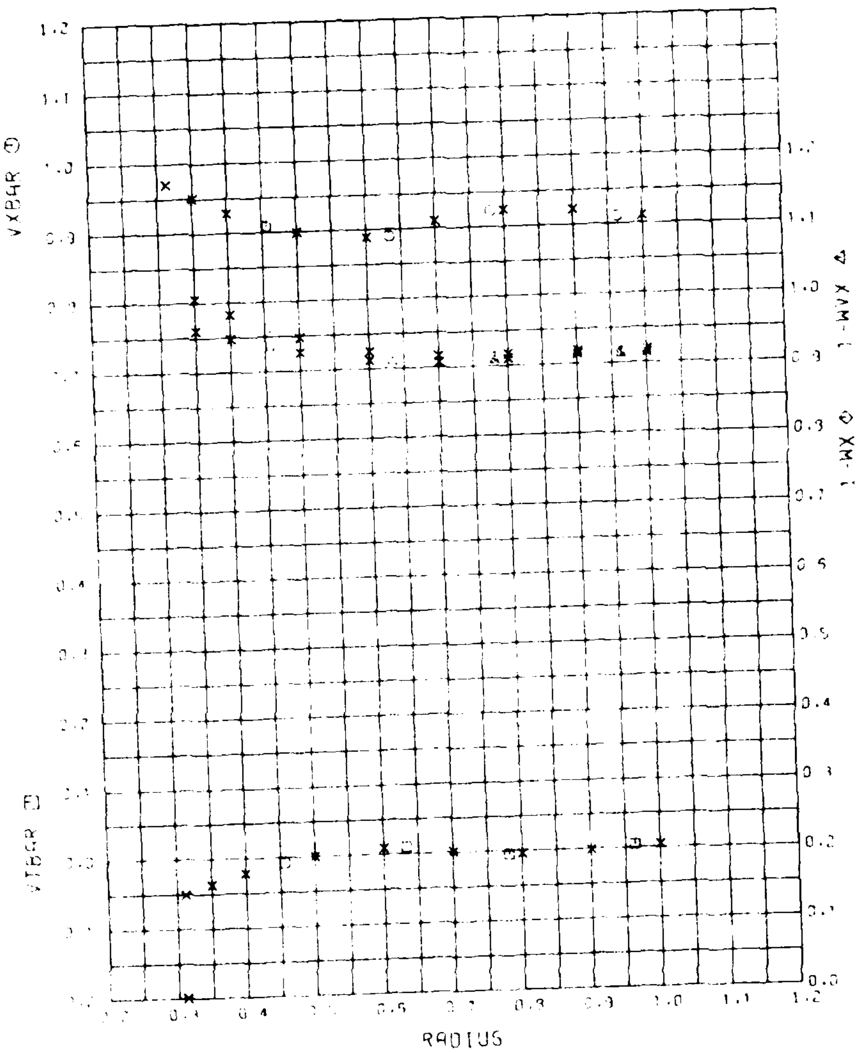

Figure G-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 15

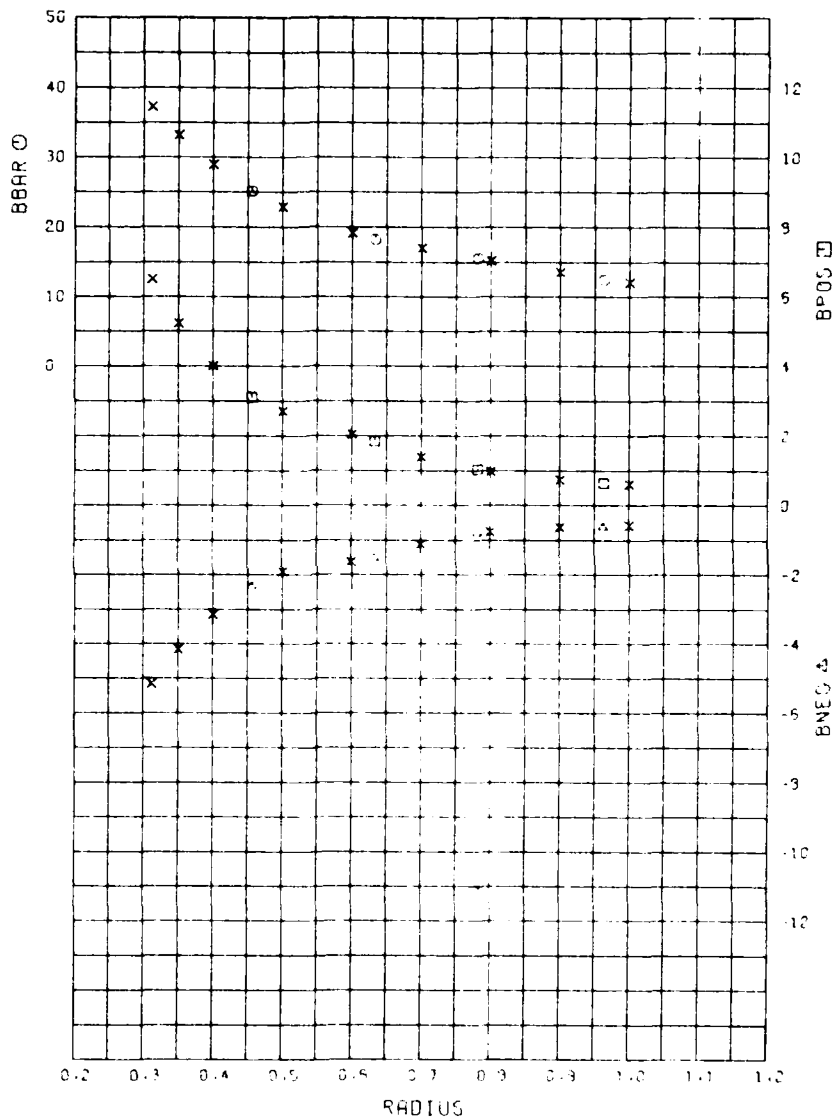

Figure G-6 - Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 15

TABLE G-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA
WITH BASS DYNAMOMETER BOAT, EXPERIMENT 15

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-2.1	.926	-.064	-.137
5.0	.918	-.030	-.136
14.0	.921	-.065	-.134
23.0	.921	-.099	-.120
32.0	.915	-.131	-.121
37.0	.919	-.167	-.116
41.0	.914	-.160	-.111
50.0	.907	-.186	-.099
59.9	.911	-.209	-.084
69.0	.916	-.221	-.060
77.1	.917	-.229	-.056
78.0	.920	-.229	-.051
86.0	.917	-.233	-.034
95.0	.922	-.229	-.015
105.1	.921	-.221	.001
113.0	.918	-.208	.016
116.0	.918	-.205	.028
123.1	.914	-.190	.032
131.0	.903	-.166	.047
136.6	.906	-.156	.059
141.1	.907	-.140	.059
150.1	.897	-.107	.069
156.0	.895	-.086	.074
159.1	.897	-.072	.075
168.1	.889	-.030	.076
186.2	.896	.022	.079
195.2	.896	.056	.076
204.2	.891	.092	.070
213.2	.896	.121	.060
222.2	.906	.140	.055
231.2	.907	.160	.035
240.0	.909	.186	.020
249.0	.909	.199	.006
257.0	.917	.203	-.010
258.9	.918	.207	-.012
267.2	.919	.207	-.025
276.1	.920	.205	-.038
278.0	.915	.206	-.045
285.0	.903	.201	-.055
293.0	.909	.189	-.078
298.0	.910	.183	-.079
302.9	.906	.173	-.085
311.0	.912	.152	-.097
316.0	.911	.135	-.108
320.0	.905	.126	-.111
323.6	.907	.117	-.114
327.0	.910	.105	-.119
330.0	.914	.092	-.122
337.0	.916	.069	-.124
338.0	.917	.066	-.129
347.0	.924	.077	-.135
356.0	.925	-.002	-.136
357.9	.926	-.006	-.137
365.0	.919	-.030	-.138

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
-6.5	.919	.022	-.160
.6	.916	-.002	-.158
8.0	.915	-.020	-.156
15.2	.914	-.051	-.151
22.6	.917	-.076	-.145
29.0	.906	-.090	-.139
36.0	.913	-.118	-.120
43.0	.909	-.139	-.119
51.2	.915	-.151	-.106
58.6	.917	-.162	-.093
65.6	.915	-.173	-.080
72.0	.905	-.180	-.064
79.0	.911	-.186	-.053
87.1	.916	-.185	-.030
94.3	.915	-.183	-.026
98.0	.910	-.180	-.016
101.6	.906	-.182	-.012
108.0	.909	-.175	.008
115.0	.903	-.167	.013
122.9	.898	-.155	.028
129.0	.885	-.141	.041
137.2	.879	-.122	.056
144.0	.865	-.105	.065
151.0	.862	-.082	.076
158.0	.864	-.057	.078
166.0	.855	-.032	.086
172.0	.859	-.007	.084
180.6	.852	.016	.085
187.5	.849	.030	.063
194.0	.855	.061	.077
201.0	.847	.087	.072
209.2	.845	.111	.063
217.0	.850	.137	.050
223.5	.855	.155	.038
230.9	.871	.172	.023
238.1	.877	.186	.008
245.0	.881	.190	-.007
252.6	.882	.200	-.022
256.0	.881	.218	-.029
259.0	.89.	.213	-.039
267.0	.890	.217	-.058
274.2	.895	.213	-.076
280.0	.90.	.208	-.089
288.0	.893	.201	-.103
295.9	.89.	.190	-.115
302.0	.896	.175	-.126
310.0	.895	.157	-.137
317.9	.897	.130	-.146
324.0	.902	.119	-.151
331.9	.905	.096	-.156
338.0	.909	.071	-.158
346.6	.914	.046	-.168
353.5	.919	.022	-.160
360.0	.916	-.002	-.158

RADIUS = .781

ANGLE	VX/V	VT/V	VR/V
-3.0	.951	.003	-.184
.6	.969	-.062	-.183
7.5	.966	-.027	-.183
14.0	.969	-.050	-.179
17.0	.966	-.058	-.179
21.0	.939	-.072	-.176
29.2	.933	-.096	-.178
36.0	.927	-.116	-.163
39.0	.927	-.125	-.159
43.0	.932	-.136	-.149
50.9	.929	-.153	-.135
58.0	.925	-.164	-.122
65.0	.925	-.181	-.105
72.0	.932	-.189	-.088
78.9	.929	-.193	-.076
79.0	.927	-.196	-.070
86.0	.929	-.199	-.058
94.2	.926	-.200	-.032
98.6	.929	-.197	-.021
101.0	.931	-.196	-.013
108.0	.927	-.186	.006
115.9	.926	-.176	.020
118.5	.921	-.176	.025
123.1	.919	-.162	.036
130.0	.917	-.146	.058
137.5	.907	-.129	.063
144.2	.909	-.123	.066
146.6	.897	-.109	.076
151.0	.901	-.088	.082
159.2	.902	-.065	.088
166.0	.899	-.048	.093
173.5	.895	-.016	.095
179.0	.902	-.000	.095
180.0	.902	.005	.095
181.0	.903	.008	.095
188.0	.902	.027	.093
195.2	.896	.050	.089
202.0	.901	.072	.082
209.6	.908	.096	.072
216.0	.911	.115	.061
219.5	.908	.125	.055
224.0	.917	.133	.048
231.2	.917	.146	.035
238.0	.921	.160	.019
245.6	.926	.171	.006
252.0	.928	.176	-.013
258.9	.929	.176	-.029
267.1	.927	.183	-.048
274.3	.929	.182	-.062
278.0	.925	.183	-.075
281.0	.925	.179	-.078
288.6	.927	.172	-.096
295.0	.923	.163	-.110
298.0	.926	.161	-.119
302.9	.926	.151	-.126
310.1	.929	.136	-.138
318.0	.934	.117	-.155
324.6	.934	.101	-.160
331.0	.939	.081	-.164
338.1	.941	.061	-.176
338.0	.947	.061	-.176
346.0	.945	.048	-.180
353.2	.948	.017	-.183
357.0	.951	.003	-.184
360.4	.949	-.007	-.181

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
0.0	.929	.003	-.189
7.0	.931	-.023	-.187
7.0	.936	-.022	-.187
14.0	.926	-.043	-.183
19.0	.920	-.057	-.180
22.0	.919	-.063	-.178
29.6	.915	-.085	-.168
36.0	.916	-.103	-.168
39.0	.916	-.109	-.156
44.0	.917	-.118	-.149
51.2	.911	-.132	-.137
58.0	.914	-.146	-.121
59.2	.917	-.148	-.119
65.6	.914	-.158	-.127
72.0	.912	-.166	-.090
79.0	.921	-.169	-.073
80.0	.915	-.169	-.064
86.0	.919	-.172	-.055
94.1	.917	-.173	-.040
100.5	.916	-.178	-.023
101.0	.919	-.178	-.023
108.0	.918	-.165	-.004
115.0	.918	-.157	.003
120.2	.916	-.158	.023
122.9	.913	-.147	.027
130.1	.911	-.133	.043
137.3	.905	-.123	.059
139.0	.905	-.111	.067
144.0	.904	-.107	.071
151.0	.908	-.087	.083
158.0	.907	-.067	.092
166.0	.901	-.033	.100
173.2	.904	-.015	.101
179.0	.898	.004	.105
180.4	.897	.005	.104
187.5	.902	.026	.102
194.0	.896	.045	.100
199.0	.893	.064	.099
202.0	.897	.071	.096
208.0	.901	.090	.086
216.0	.901	.113	.077
219.0	.896	.121	.072
223.0	.899	.131	.064
230.9	.901	.144	.049
237.1	.907	.159	.033
239.1	.906	.161	.028
245.0	.908	.176	.011
252.6	.908	.182	-.007
258.0	.908	.186	-.020
259.0	.910	.186	-.023
267.0	.909	.191	-.047
274.2	.908	.190	-.067
278.6	.909	.187	-.076
281.6	.905	.186	-.085
288.0	.901	.177	-.103
295.9	.907	.165	-.118
298.5	.907	.161	-.126
303.1	.906	.153	-.134
310.0	.908	.137	-.144
318.6	.917	.117	-.154
324.0	.911	.102	-.168
331.9	.918	.082	-.177
339.2	.926	.062	-.182
346.0	.926	.040	-.186
353.5	.929	.021	-.188
360.0	.928	.003	-.183

TABLE G-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 15

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 6KTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.909	.890	.923	.911	.971	.951	.928	.899	.889	.910	.924	.922	.911
VTBAR =	-.008	.010	-.004	.005	-.051	-.037	-.022	-.000	.009	.001	-.004	-.001	.005
VRBAR =	-.028	-.043	-.047	-.047	-.008	-.014	-.022	-.033	-.041	-.045	-.047	-.047	-.047
1-WVX =	.934	.909	.908	.912	0.000	.960	.947	.926	.912	.907	.910	.914	.914
1-WX =	.963	.921	.914	.917	0.000	1.006	.982	.947	.925	.916	.917	.919	.919
BBAR =	25.21	18.24	15.55	12.52	37.26	33.22	28.93	22.91	19.14	16.99	15.22	13.54	12.07
BPOS =	3.11	1.85	1.03	.65	6.51	5.23	4.01	2.71	2.04	1.39	.98	.74	.61
THETA =	95.00	90.00	100.00	85.00	100.00	100.00	100.00	92.50	90.00	85.00	102.50	102.50	85.00
BNEG =	-2.34	-1.53	-.80	-.62	-5.16	-4.16	-3.15	-1.91	-1.64	-1.12	-.76	-.63	-.58
THETA =	285.00	222.50	267.50	287.50	282.50	282.50	285.00	250.00	222.50	220.00	267.50	280.00	287.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE G-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 15

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 6KTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0099	.0059	.0059	.0027	.0010	.0008	.0007	.0006
PHASE ANGLE =	73.0	274.9	87.3	78.8	291.9	305.3	351.0	82.8
RADIUS = .633								
AMPLITUDE =	.0304	.0102	.0048	.0040	.0017	.0022	.0004	.0009
PHASE ANGLE =	68.2	259.3	83.5	102.6	237.0	111.8	280.8	21.3
RADIUS = .781								
AMPLITUDE =	.0187	.0030	.0071	.0029	.0006	.0014	.0006	.0003
PHASE ANGLE =	91.4	283.9	105.6	98.7	279.3	88.9	12.8	330.7
RADIUS = .963								
AMPLITUDE =	.0103	.0012	.0055	.0034	.0001	.0004	.0007	.0002
PHASE ANGLE =	62.8	147.8	94.7	107.0	159.4	102.5	68.0	175.8

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0019	.0007	.0009	.0005	.0007	.0007	.0007	.0006
PHASE ANGLE =	180.6	356.1	73.2	46.5	146.4	205.6	151.4	81.7
RADIUS = .633								
AMPLITUDE =	.0008	.0020	.0009	.0003	.0010	.0004	.0011	.0009
PHASE ANGLE =	78.3	261.1	195.5	149.3	60.4	239.8	211.8	184.1
RADIUS = .781								
AMPLITUDE =	.0006	.0004	.0010	.0007	.0012	.0007	.0006	.0005
PHASE ANGLE =	27.5	75.0	270.7	294.0	211.0	72.1	172.7	34.0
RADIUS = .963								
AMPLITUDE =	.0003	.0007	.0004	.0012	.0005	.0005	.0004	.0006
PHASE ANGLE =	70.7	40.4	311.8	77.8	315.4	324.4	286.7	293.5

TABLE G-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 15

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INL UKTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0372	.0105	.0101	.0033	.0036	.0064	.0024	.0018
PHASE ANGLE =	233.7	47.7	104.2	349.0	13.4	300.8	20.8	162.5
RADIUS = .350								
AMPLITUDE =	.0223	.0058	[illegible]	.0024	.0025	.0046	.0019	.0013
PHASE ANGLE =	231.6	33.1	105.2	10.1	6.0	300.8	17.0	153.2
RADIUS = .400								
AMPLITUDE =	.0059	.0031	[illegible]	.0021	.0014	.0026	.0012	.0008
PHASE ANGLE =	214.0	328.5	94.2	48.6	345.0	301.2	8.8	129.7
RADIUS = .500								
AMPLITUDE =	.0187	[illegible]	[illegible]	.0032	.0012	.0004	.0005	.0007
PHASE ANGLE =	67.1	[illegible]	[illegible]	[illegible]	[illegible]	104.4	326.7	53.5
RADIUS = .600								
AMPLITUDE =	.0296	.0105	[illegible]	.0040	.0017	.0019	.0004	.0009
PHASE ANGLE =	67.0	259.5	[illegible]	101.3	238.4	112.9	281.8	26.3
RADIUS = .700								
AMPLITUDE =	.0241	.0064	[illegible]	.0033	.0011	.0018	.0004	.0006
PHASE ANGLE =	80.0	257.6	[illegible]	100.0	251.8	100.5	341.7	3.7
RADIUS = .800								
AMPLITUDE =	.0177	.0024	.0072	.0018	.0005	.0013	.0007	.0003
PHASE ANGLE =	93.0	[illegible]	106.0	98.8	286.8	86.8	17.6	321.3
RADIUS = .900								
AMPLITUDE =	.0122	.0002	[illegible]	.0030	.0002	.0008	.0007	.0001
PHASE ANGLE =	87.8	16.2	103.2	102.9	320.5	82.6	43.6	[illegible]
RADIUS = 1.000								
AMPLITUDE =	.0103	.0012	.0055	.0034	.0001	.0004	.0007	.0002
PHASE ANGLE =	[illegible]	147.6	[illegible]	137.0	159.4	102.5	68.0	175.8

TABLE G-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC GKTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0052	.0060	.0036	.0019	.0043	.0013	.0025	.0035
PHASE ANGLE =	201.8	63.0	33.5	355.9	207.7	141.0	84.0	34.5
RADIUS = .350								
AMPLITUDE =	.0041	.0042	.0027	.0014	.0030	.0010	.0018	.0025
PHASE ANGLE =	198.5	59.9	38.4	2.2	203.7	155.6	90.8	38.0
RADIUS = .400								
AMPLITUDE =	.0029	.0021	.0018	.0008	.0016	.0008	.0011	.0014
PHASE ANGLE =	192.3	50.4	48.7	15.9	192.5	180.2	108.5	47.3
RADIUS = .500								
AMPLITUDE =	.0012	.0011	.0006	.0004	.0007	.0007	.0008	.0005
PHASE ANGLE =	163.9	286.2	112.7	82.1	89.0	219.7	184.9	142.3
RADIUS = .600								
AMPLITUDE =	.0008	.0020	.0009	.0004	.0011	.0006	.0011	.0009
PHASE ANGLE =	95.5	263.0	183.4	135.1	60.9	236.9	210.4	182.0
RADIUS = .700								
AMPLITUDE =	.0007	.0006	.0009	.0005	.0005	.0003	.0008	.0002
PHASE ANGLE =	50.8	260.1	239.3	276.6	179.4	89.1	192.1	117.0
RADIUS = .800								
AMPLITUDE =	.0006	.0006	.0011	.0007	.0013	.0007	.0005	.0006
PHASE ANGLE =	24.7	74.3	275.4	298.0	213.5	69.5	170.0	28.0
RADIUS = .900								
AMPLITUDE =	.0004	.0009	.0010	.0004	.0009	.0005	.0002	.0006
PHASE ANGLE =	30.2	63.8	296.2	26.0	231.5	38.1	204.6	348.0
RADIUS = 1.000								
AMPLITUDE =	.0003	.0007	.0008	.0012	.0005	.0005	.0004	.0006
PHASE ANGLE =	70.7	40.4	314.8	77.8	315.4	324.4	286.7	293.5

TABLE G-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 15

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 6KTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.2203	.0033	.0038	.0004	.0019	.0006	.0008	.0005
PHASE ANGLE =	182.2	103.0	32.3	291.2	19.6	169.3	41.8	201.6
RADIUS = .633								
AMPLITUDE =	.2005	.0040	.0005	.0012	.0012	.0004	.0008	.0003
PHASE ANGLE =	182.3	260.2	49.0	114.8	12.7	153.7	14.2	129.4
RADIUS = .781								
AMPLITUDE =	.1899	.0039	.0020	.0002	.0008	.0005	.0003	.0004
PHASE ANGLE =	181.3	71.1	12.6	257.9	31.9	114.6	356.4	162.0
RADIUS = .963								
AMPLITUDE =	.1799	.0041	.0017	.0008	.0003	.0004	.0002	.0002
PHASE ANGLE =	180.7	310.9	10.4	86.0	43.6	201.3	81.1	105.2

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0007	.0004	.0003	.0005	.0002	.0002	.0001	.0003
PHASE ANGLE =	25.5	166.3	49.5	302.6	312.9	28.0	298.5	153.0
RADIUS = .633								
AMPLITUDE =	.0006	.0004	.0003	.0007	.0003	.0003	.0003	.0005
PHASE ANGLE =	334.6	180.5	52.8	149.8	273.2	224.0	344.0	137.1
RADIUS = .781								
AMPLITUDE =	.0002	.0002	.0001	.0002	.0003	.0002	.0006	.0002
PHASE ANGLE =	51.4	99.8	250.3	337.5	110.4	79.8	354.8	287.0
RADIUS = .963								
AMPLITUDE =	.0001	.0001	.0005	.0002	.0004	.0006	.0003	.0002
PHASE ANGLE =	256.3	59.1	270.8	145.5	94.3	179.7	51.4	134.5

TABLE G-6 – HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 15

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 6KTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2422	.0223	.0028	.0045	.0027	.0008	.0010	.0016
PHASE ANGLE =	181.3	96.6	10.3	292.1	31.2	164.7	91.9	220.7
RADIUS = .350								
AMPLITUDE =	.2359	.0162	.0021	.0032	.0025	.0007	.0009	.0013
PHASE ANGLE =	181.6	97.2	13.1	292.1	28.1	166.8	77.3	218.3
RADIUS = .400								
AMPLITUDE =	.2282	.0093	.0014	.0017	.0022	.0007	.0008	.0009
PHASE ANGLE =	181.9	98.6	19.1	292.1	23.9	168.7	58.7	213.1
RADIUS = .500								
AMPLITUDE =	.2146	.0004	.0005	.0003	.0017	.0006	.0009	.0004
PHASE ANGLE =	182.3	210.1	48.9	114.9	16.6	168.3	32.1	184.6
RADIUS = .600								
AMPLITUDE =	.2036	.0039	.0005	.0012	.0013	.0005	.0008	.0003
PHASE ANGLE =	182.4	277.2	61.1	114.2	12.6	159.4	17.6	135.3
RADIUS = .700								
AMPLITUDE =	.1954	.0013	.0014	.0004	.0010	.0005	.0005	.0004
PHASE ANGLE =	181.8	47.7	18.6	134.8	21.6	125.4	5.6	153.6
RADIUS = .800								
AMPLITUDE =	.1887	.0041	.0021	.0003	.0007	.0004	.0002	.0004
PHASE ANGLE =	181.2	70.2	12.0	266.4	34.1	114.9	355.8	162.1
RADIUS = .900								
AMPLITUDE =	.1830	.0024	.0021	.0001	.0005	.0003	.0001	.0003
PHASE ANGLE =	180.8	31.6	10.3	58.3	43.1	147.0	45.8	147.9
RADIUS = 1.000								
AMPLITUDE =	.1799	.0041	.0017	.0008	.0003	.0004	.0002	.0002
PHASE ANGLE =	180.7	310.9	10.4	88.0	43.6	201.3	81.1	105.2

TABLE G-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC GKTSW015
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0016	.0005	.0001	.0029	.0006	.0014	.0002	.0007
PHASE ANGLE =	80.3	88.4	284.9	319.5	61.5	41.9	227.9	294.5
RADIUS = .350								
AMPLITUDE =	.0012	.0004	.0001	.0021	.0004	.0010	.0001	.0004
PHASE ANGLE =	71.3	110.3	11.2	318.3	49.0	40.7	241.4	286.4
RADIUS = .400								
AMPLITUDE =	.0009	.0004	.0002	.0012	.0002	.0006	.0001	.0001
PHASE ANGLE =	53.4	142.8	42.5	315.1	9.8	37.8	266.7	235.2
RADIUS = .500								
AMPLITUDE =	.0007	.0005	.0003	.0002	.0003	.0001	.0002	.0004
PHASE ANGLE =	4.3	175.6	51.7	214.1	293.8	307.7	317.3	142.4
RADIUS = .600								
AMPLITUDE =	.0007	.0005	.0003	.0006	.0003	.0003	.0003	.0005
PHASE ANGLE =	338.0	181.9	53.1	151.9	277.3	227.9	339.8	137.0
RADIUS = .700								
AMPLITUDE =	.0003	.0003	.0001	.0002	.0001	.0000	.0005	.0001
PHASE ANGLE =	356.2	148.0	54.4	145.5	181.8	102.8	349.2	170.5
RADIUS = .800								
AMPLITUDE =	.0002	.0002	.0002	.0002	.0003	.0002	.0006	.0002
PHASE ANGLE =	64.3	92.2	251.4	336.5	108.3	85.2	356.6	289.9
RADIUS = .900								
AMPLITUDE =	.0001	.0002	.0004	.0001	.0004	.0003	.0004	.0001
PHASE ANGLE =	112.9	69.4	262.2	346.0	100.4	148.9	14.3	275.2
RADIUS = 1.000								
AMPLITUDE =	.0001	.0001	.0005	.0002	.0004	.0006	.0003	.0002
PHASE ANGLE =	256.3	59.1	270.8	145.5	94.3	179.7	51.4	134.5

APPENDIX H

VELOCITY COMPONENT RATIOS AND HARMONIC ANALYSIS

FOR EXPERIMENT 16

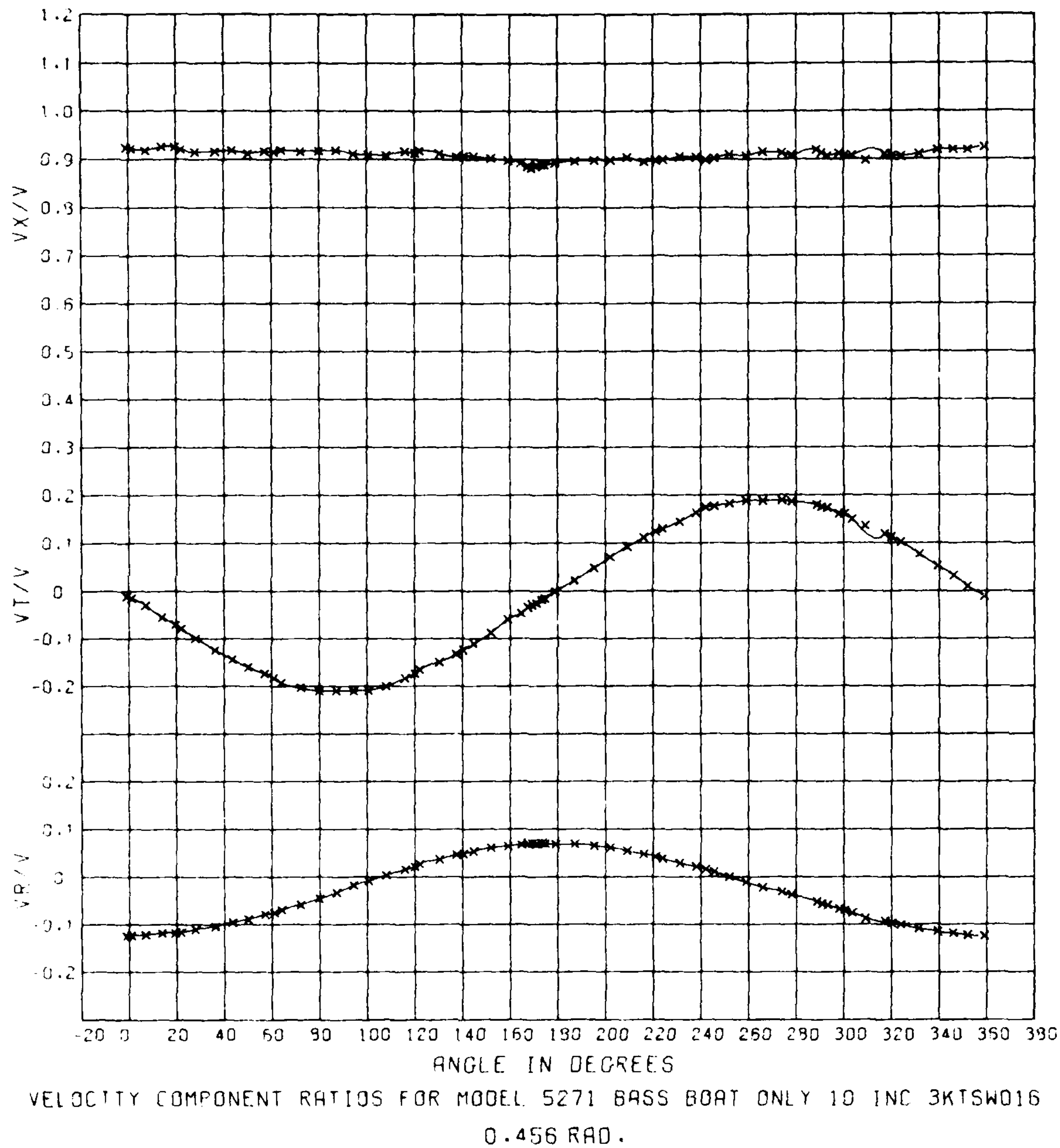

Figure H-1 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.456 for Experiment 16

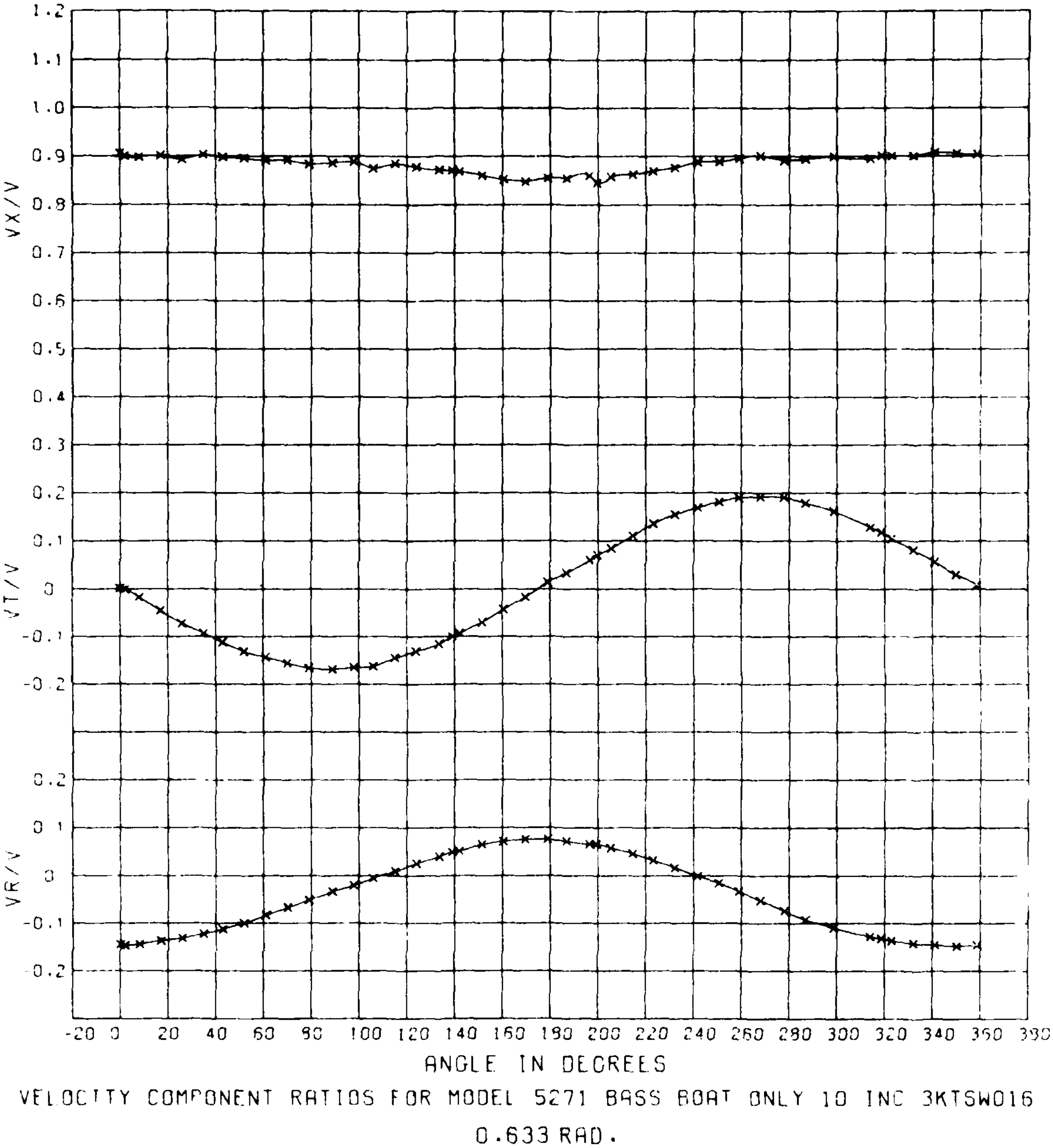

Figure H-2 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.633 for Experiment 16

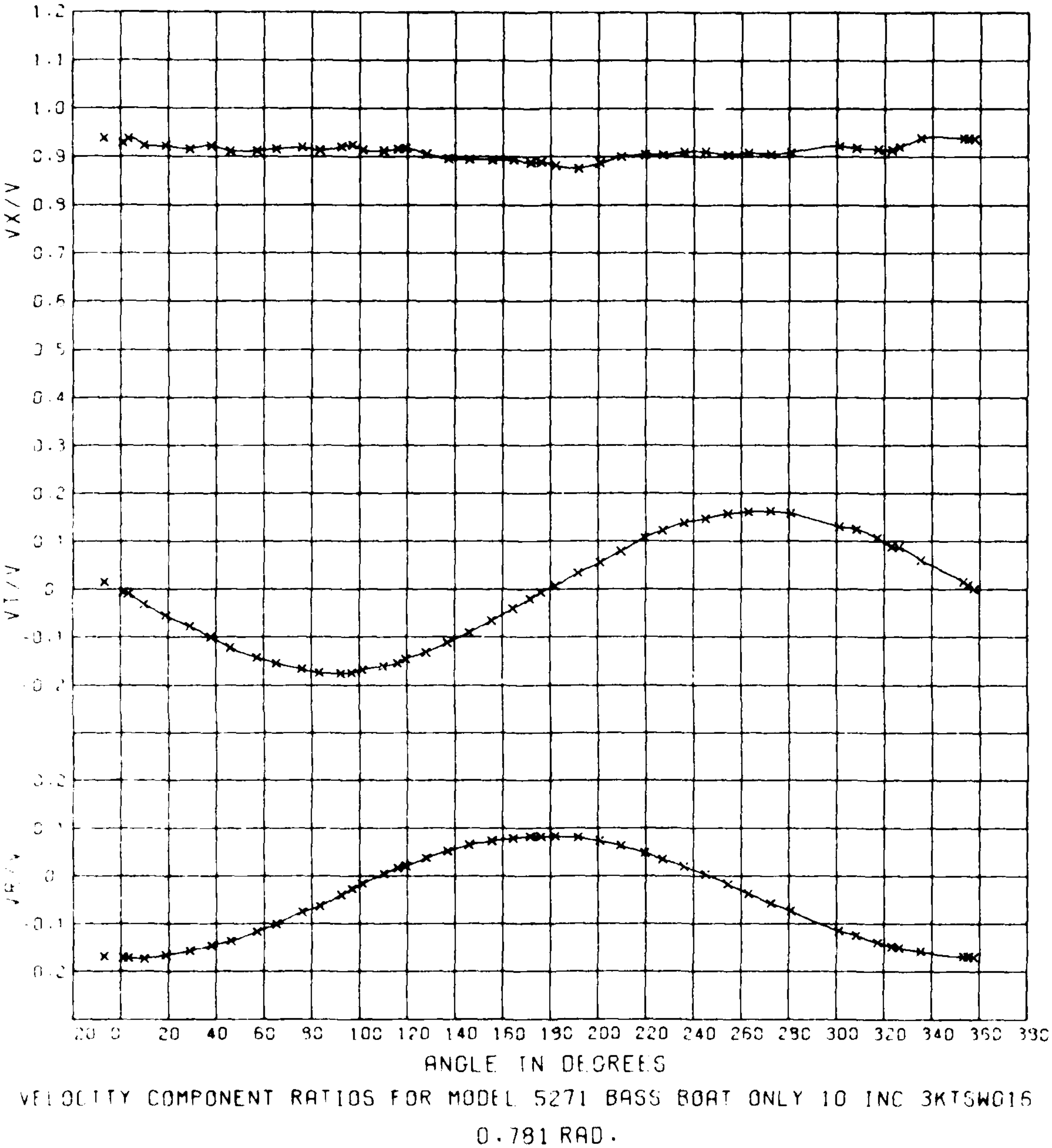

Figure H-3 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.781 for Experiment 16

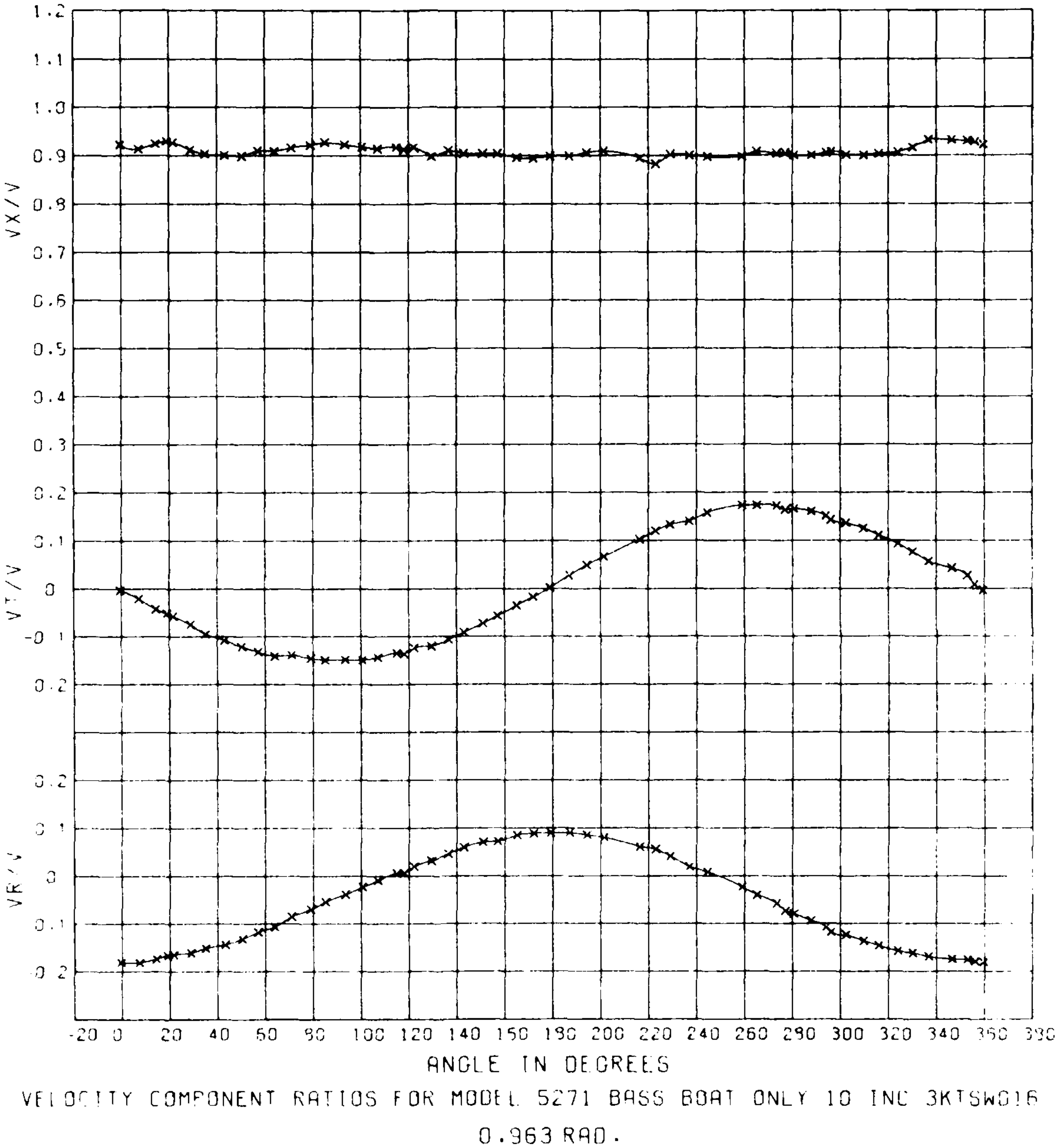

Figure H-4 - Circumferential Distribution of the Longitudinal, Tangential, and Radial Velocity Component Ratios - Radius Ratio = 0.963 for Experiment 16

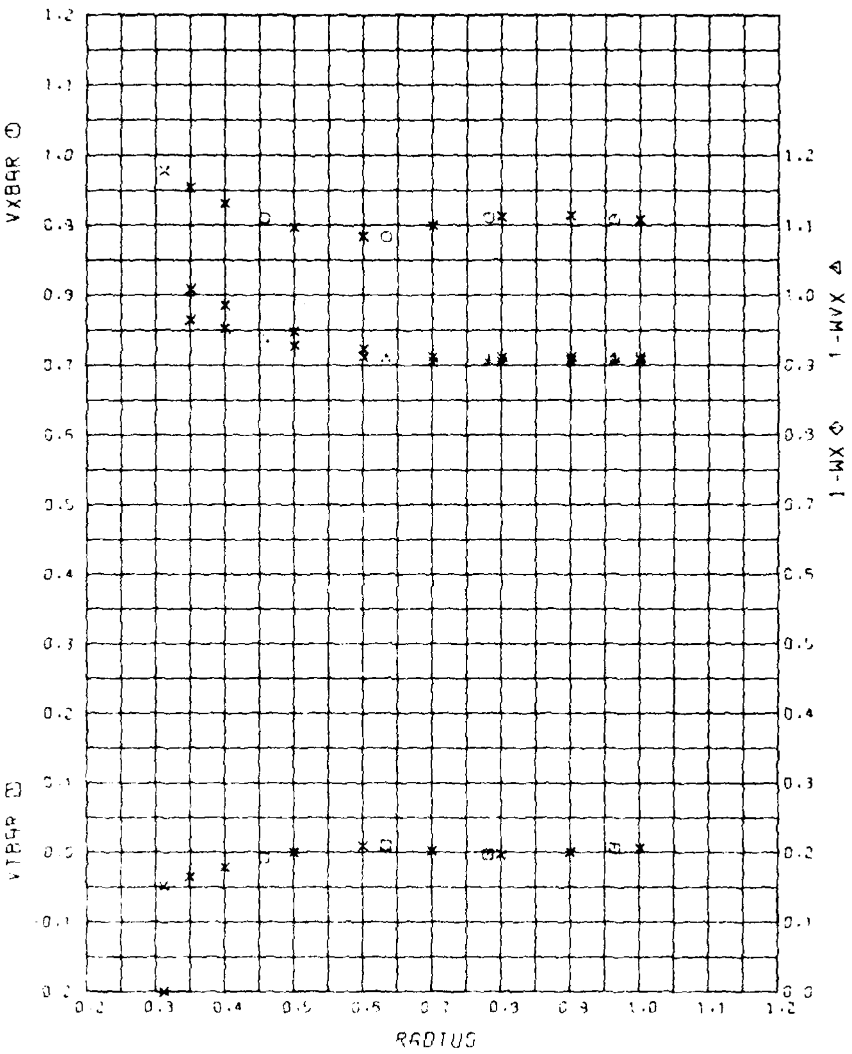

Figure H-5 - Radial Distribution of the Mean Velocity Component Ratios for Experiment 16

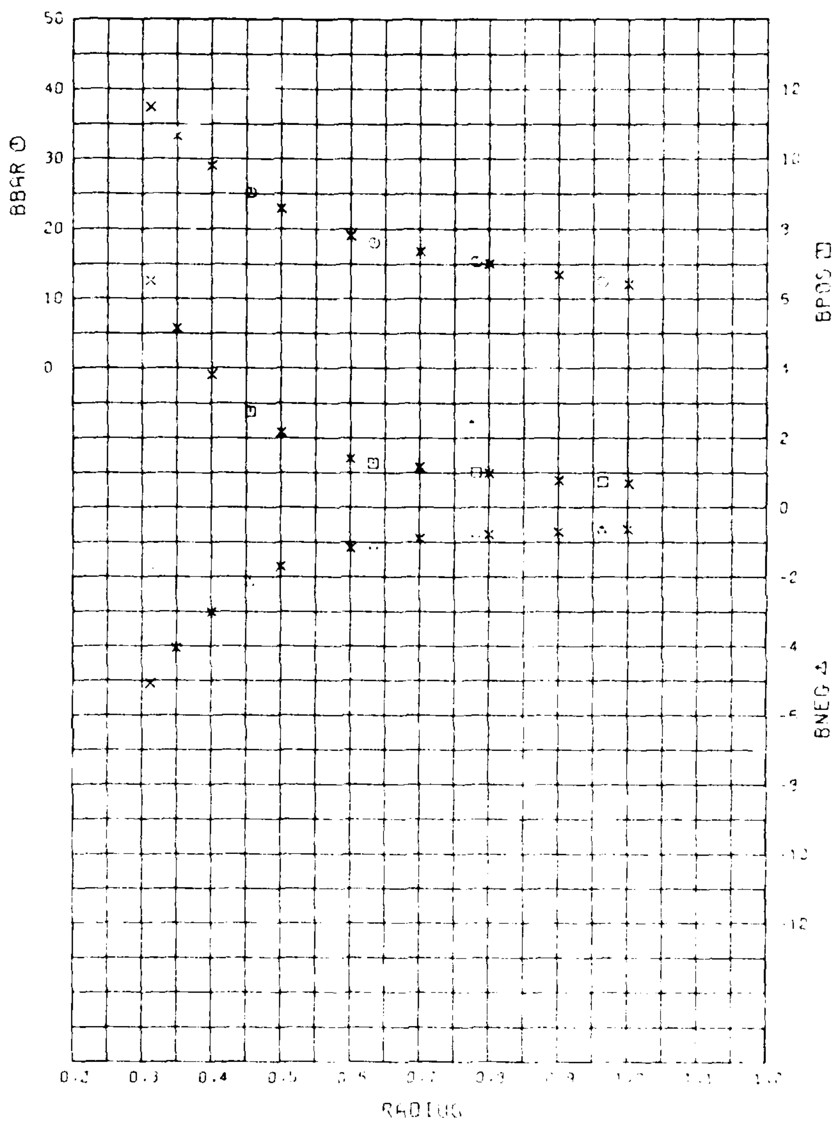

Figure H-6 – Radial Distribution of the Mean Advance Angle and Advance Angle Variations for Experiment 16

TABLE H-1

INPUT DATA FOR HARMONIC ANALYSIS FOR R/V ATHENA
WITH BASS DYNAMOMETER BOAT, EXPERIMENT 16

RADIUS = .456

ANGLE	VX/V	VT/V	VR/V
-1.0	.924	-.011	-.124
1.0	.923	-.015	-.123
7.0	.910	-.030	-.121
14.0	.927	-.045	-.118
19.5	.926	-.070	-.117
21.9	.920	-.078	-.116
28.0	.915	-.099	-.110
36.3	.916	-.124	-.104
43.4	.919	-.144	-.095
50.0	.911	-.160	-.088
57.0	.917	-.173	-.078
60.9	.914	-.182	-.075
64.0	.919	-.193	-.069
72.0	.916	-.203	-.058
79.6	.915	-.210	-.046
88.0	.910	-.218	-.045
97.0	.919	-.218	-.033
94.2	.912	-.210	-.018
100.9	.909	-.209	-.008
108.0	.908	-.208	.004
115.9	.916	-.182	.016
120.0	.913	-.173	.022
122.0	.918	-.165	.027
130.3	.922	-.149	.037
137.4	.906	-.133	.044
140.3	.906	-.124	.049
144.0	.907	-.111	.054
151.0	.902	-.088	.061
159.0	.897	-.099	.065
164.6	.893	-.067	.067
167.6	.885	-.035	.070
169.2	.881	-.030	.070
171.0	.886	-.026	.069
172.0	.891	-.018	.069
173.4	.889	-.019	.072
174.6	.889	-.016	.070
179.0	.892	-.001	.080
187.0	.897	.022	.069
195.2	.897	.040	.066
202.0	.899	.071	.062
209.0	.904	.092	.055
216.0	.895	.112	.048
221.0	.897	.124	.043
223.9	.899	.138	.039
231.2	.906	.145	.029
238.0	.904	.164	.022
247.0	.899	.174	.016
249.6	.903	.176	.011
252.0	.909	.182	.000
259.0	.907	.188	-.011
266.0	.915	.188	-.022
274.0	.913	.188	-.031
278.0	.904	.186	-.037
280.6	.920	.179	-.052
290.3	.914	.176	-.055
291.0	.918	.175	-.058
293.0	.904	.173	-.059
298.0	.911	.160	-.060
300.0	.909	.160	-.070
308.1	.905	.151	-.069
317.2	.912	.119	-.093
302.4	.909	.149	-.076
303.4	.906	.151	-.076
309.0	.898	.136	-.087
320.1	.908	.114	-.096
320.1	.907	.112	-.099
324.0	.906	.102	-.101
331.6	.910	.077	-.100
339.0	.917	.051	-.113
339.9	.919	.052	-.115
346.0	.920	.033	-.110
352.0	.919	.010	-.122
359.0	.924	-.011	-.124
361.0	.923	-.015	-.123

RADIUS = .633

ANGLE	VX/V	VT/V	VR/V
0.0	.905	.001	-.144
1.9	.899	-.000	-.146
8.0	.899	-.018	-.143
17.0	.901	-.046	-.136
25.9	.893	-.072	-.131
34.9	.902	-.093	-.122
43.0	.890	-.112	-.112
52.0	.895	-.131	-.099
61.0	.891	-.142	-.083
70.0	.891	-.155	-.067
79.0	.886	-.165	-.051
88.9	.886	-.168	-.034
97.0	.889	-.165	-.021
106.0	.875	-.162	-.005
115.0	.885	-.144	.010
124.0	.879	-.130	.026
133.6	.871	-.116	.048
139.0	.871	-.100	.049
142.0	.869	-.093	.051
151.5	.866	-.069	.065
160.5	.853	-.043	.071
169.6	.868	-.017	.076
179.0	.855	.014	.075
187.0	.856	.033	.072
196.5	.861	.060	.066
199.5	.865	.078	.066
205.6	.858	.085	.058
214.9	.863	.111	.046
223.0	.878	.136	.032
232.0	.876	.155	.017
241.6	.888	.169	-.001
250.6	.888	.181	-.015
259.0	.895	.190	-.033
268.0	.901	.190	-.052
277.0	.891	.191	-.073
286.0	.894	.179	-.092
290.6	.899	.162	-.109
313.0	.895	.129	-.127
318.5	.901	.119	-.131
322.0	.900	.105	-.135
331.0	.900	.082	-.141
340.0	.908	.057	-.144
347.9	.906	.030	-.147
350.0	.907	.024	-.146
359.0	.901	.007	-.145
360.0	.905	.001	-.144

RADIUS = .701

ANGLE	VX/V	VT/V	VR/V
-6.9	.930	.015	-.169
1.0	.928	-.006	-.172
3.3	.937	-.010	-.171
10.0	.923	-.032	-.173
19.0	.922	-.056	-.166
29.0	.916	-.079	-.158
38.0	.927	-.100	-.147
46.0	.911	-.122	-.136
57.0	.917	-.143	-.117
65.1	.915	-.154	-.101
76.0	.919	-.167	-.076
83.3	.913	-.174	-.064
92.3	.920	-.176	-.040
96.9	.924	-.175	-.027
101.3	.914	-.169	-.016
110.0	.912	-.161	.004
116.0	.916	-.155	.016
119.6	.917	-.147	.021
128.0	.905	-.132	.038
137.0	.895	-.113	.052
146.0	.895	-.091	.065
155.4	.893	-.066	.073
164.4	.894	-.040	.079
171.6	.888	-.020	.082
178.0	.889	-.006	.082
182.0	.881	.007	.083
191.6	.876	.036	.080
200.6	.887	.056	.073
209.5	.900	.079	.064
219.6	.906	.107	.049
227.0	.904	.123	.035
236.0	.909	.138	.019
245.0	.911	.147	.003
254.6	.903	.157	-.017
263.0	.908	.161	-.037
272.6	.905	.163	-.050
280.5	.925	.155	-.073
291.0	.893	.161	-.075
301.0	.927	.131	-.115
308.2	.918	.125	-.124
317.1	.915	.108	-.139
323.0	.914	.088	-.149
326.1	.919	.067	-.150
335.1	.938	.048	-.158
345.3	.951	.032	-.162
353.1	.938	.015	-.169
363.3	.937	-.010	-.171

RADIUS = .963

ANGLE	VX/V	VT/V	VR/V
-1.0	.924	-.002	-.177
0.0	.921	-.006	-.183
7.3	.913	-.021	-.181
14.6	.924	-.042	-.173
19.0	.929	-.053	-.166
21.6	.927	-.057	-.164
28.0	.911	-.076	-.160
35.0	.903	-.095	-.151
43.1	.900	-.100	-.143
50.3	.899	-.121	-.132
57.0	.916	-.132	-.117
64.0	.908	-.140	-.106
71.0	.916	-.130	-.086
79.0	.922	-.145	-.069
85.0	.920	-.149	-.053
93.3	.923	-.144	-.039
100.9	.918	-.149	-.023
107.0	.915	-.143	-.009
114.9	.918	-.136	.006
118.0	.912	-.136	.006
122.1	.917	-.123	.020
129.6	.897	-.121	.032
136.5	.910	-.107	.047
143.0	.904	-.091	.060
153.9	.904	-.072	.070
157.0	.904	-.057	.072
165.0	.896	-.035	.085
172.0	.894	-.017	.080
179.0	.898	.002	.090
186.9	.899	.029	.090
194.1	.905	.049	.086
201.3	.909	.067	.080
215.6	.898	.103	.066
217.0	.898	.102	.056
222.9	.892	.121	.056
229.0	.902	.133	.041
237.0	.900	.140	.019
244.5	.897	.156	.009
250.9	.898	.173	-.023
265.0	.908	.173	-.040
273.3	.904	.173	-.057
276.9	.906	.166	-.073
280.5	.900	.166	-.078
287.0	.900	.161	-.093
294.0	.905	.151	-.107
296.0	.908	.143	-.110
302.3	.901	.137	-.123
309.6	.900	.126	-.136
316.0	.903	.111	-.145
323.9	.906	.093	-.157
330.0	.916	.077	-.161
336.6	.932	.057	-.168
346.3	.931	.042	-.174
352.9	.930	.027	-.175
356.0	.920	.009	-.178
359.0	.924	-.002	-.177
360.0	.921	-.006	-.183

TABLE H-2 - LISTING OF THE MEAN VELOCITY COMPONENT RATIOS, THE MEAN ADVANCE ANGLES AND OTHER DERIVED QUANTITIES AT THE EXPERIMENTAL AND INTERPOLATED RADII FOR EXPERIMENT 16

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER = 6.00 FEET JA = .739

RADIUS =	.456	.633	.781	.963	.312	.350	.400	.500	.600	.700	.800	.900	1.000
VXBAR =	.910	.884	.911	.908	.977	.955	.931	.897	.884	.899	.912	.913	.908
VTBAR =	-.008	.010	-.003	.006	-.048	-.035	-.021	.000	.009	.002	-.003	-.000	.006
VRBAR =	-.026	-.041	-.046	-.047	-.008	-.013	-.029	-.031	-.039	-.044	-.046	-.047	-.047
1-WVX =	.937	.909	.903	.906	0.000	.965	.952	.928	.912	.905	.905	.907	.908
1-WX =	.964	.918	.909	.910	0.000	1.009	.985	.946	.923	.912	.911	.912	.912
BBAR =	25.22	18.12	15.34	12.49	37.38	33.3[illegible]	28.[illegible]	22.[illegible]	19.05	16.80	15.02	13.42	12.04
BPOS =	2.76	1.27	1.02	.74	6.52	5.16	3.[illegible]	2.[illegible]	1.40	1.16	.98	.78	.70
THETA =	85.00	95.00	95.00	85.00	80.00	80.00	82.50	[illegible]	92.50	95.00	95.00	95.00	85.00
BNEG =	-2.18	-1.13	-.79	-.66	-5.07	-4.06	-3.02	-1.70	-1.18	-.90	-.77	-.69	-.63
THETA =	242.50	200.00	255.00	222.50	260.00	242.50	242.50	242.50	200.00	200.00	255.00	255.00	222.50

VXBAR IS CIRCUMFERENTIAL MEAN LONGITUDINAL VELOCITY.
VTBAR IS CIRCUMFERENTIAL MEAN TANGENTIAL VELOCITY.
VRBAR IS CIRCUMFERENTIAL MEAN RADIAL VELOCITY.
1-WVX IS VOLUMETRIC MEAN WAKE VELOCITY WITHOUT TANGENTIAL CORRECTION.
1-WX IS VOLUMETRIC MEAN WAKE VELOCITY WITH TANGENTIAL CORRECTION.
BBAR IS MEAN ANGLE OF ADVANCE.
BPOS IS VARIATION BETWEEN THE MAXIMUM AND MEAN ADVANCE ANGLES (DELTA BETA PLUS).
BNEG IS VARIATION BETWEEN THE MINIMUM AND MEAN ADVANCE ANGLES (DELTA BETA MINUS).
THETA IS ANGLE IN DEGREES AT WHICH CORRESPONDING BPOS OR BNEG OCCURS.

TABLE B-3 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 16

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.0106	.0032	.0032	.0016	.0029	.0017	.0004	.0002
PHASE ANGLE =	74.2	264.9	71.7	21.0	122.4	9.5	200.2	170.6
RADIUS = .633								
AMPLITUDE =	.0220	.0068	.0045	.0010	.0025	.0005	.0015	.0008
PHASE ANGLE =	98.3	267.2	74.0	190.6	209.8	69.4	192.2	92.4
RADIUS = .781								
AMPLITUDE =	.0176	.0032	.0077	.0014	.0023	.0037	.0006	.0033
PHASE ANGLE =	88.2	229.0	118.8	168.2	65.6	165.2	210.1	211.8
RADIUS = .963								
AMPLITUDE =	.0102	.0029	.0065	.0056	.0021	.0025	.0024	.0032
PHASE ANGLE =	53.9	157.1	134.8	90.4	126.6	291.4	217.6	271.8

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0012	.0014	.0014	.0005	.0018	.0010	.0012	.0012
PHASE ANGLE =	145.2	294.6	236.8	323.8	306.9	60.0	164.3	139.2
RADIUS = .633								
AMPLITUDE =	.0011	.0010	.0015	.0009	.0014	.0018	.0010	.0004
PHASE ANGLE =	224.9	356.5	166.8	68.4	255.2	272.2	98.8	337.1
RADIUS = .781								
AMPLITUDE =	.0008	.0004	.0010	.0019	.0015	.0003	.0010	.0002
PHASE ANGLE =	337.3	282.3	1.3	48.6	299.9	241.2	86.9	28.1
RADIUS = .963								
AMPLITUDE =	.0016	.0033	.0012	.0026	.0008	.0001	.0011	.0008
PHASE ANGLE =	206.5	269.1	[illegible]	152.3	251.6	12.8	179.7	77.3

TABLE H-4 - HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 16

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASE BOAT ONLY 10 IND 3KTSAC16
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.0206	.0071	.0053	.0057	.0118	.0007	.0024	.0049
PHASE ANGLE =	322.0	105.3	141.2	23.5	78.1	42.3	4.2	227.8
RADIUS = .350								
AMPLITUDE =	.0132	.0038	[illegible]	[illegible]	.0087	.0011	.0015	.0032
PHASE ANGLE =	335.4	110.1	[illegible]	22.9	82.8	20.2	3.0	225.9
RADIUS = .400								
AMPLITUDE =	.0077	.0037	[illegible]	.0030	.0053	.0015	.0005	.0015
PHASE ANGLE =	20.7	183.1	[illegible]	22.0	93.9	11.9	356.4	223.3
RADIUS = .500								
AMPLITUDE =	.0148	.0050	[illegible]	.0007	.0023	.0016	.0009	.0005
PHASE ANGLE =	68.8	264.9	[illegible]	20.8	160.9	10.1	192.9	[illegible]
RADIUS = .600								
AMPLITUDE =	.0212	.0069	.0043	.0007	.0027	.0008	.0015	.0010
PHASE ANGLE =	97.9	268.7	66.7	192.3	206.2	29.6	191.6	[illegible]
RADIUS = .700								
AMPLITUDE =	.0203	.0048	.0041	.0014	.0007	.0026	.0009	.0019
PHASE ANGLE =	94.4	254.7	104.0	[illegible]	108.0	156.3	[illegible]	[illegible]
RADIUS = .800								
AMPLITUDE =	.0168	.0029	.0079	.0014	.0025	.0037	.0007	.0035
PHASE ANGLE =	86.3	221.0	121.0	[illegible]	65.7	167.3	214.0	[illegible]
RADIUS = .900								
AMPLITUDE =	.0126	.0027	.0078	.0032	.0024	.0019	.0014	.0034
PHASE ANGLE =	71.5	176.8	129.5	[illegible]	83.7	201.0	219.6	[illegible]
RADIUS = 1.000								
AMPLITUDE =	.0102	.0029	.0015	[illegible]	.0021	.0025	.0024	.0032
PHASE ANGLE =	53.9	157.1	[illegible]	[illegible]	120.6	291.4	217.6	[illegible]

TABLE H-4 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER 6.00 FEET JA = .739

HARMONIC ANALYSES OF LONGITUDINAL VELOCITY COMPONENT RATIOS (VX/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0033	.0038	.0033	.0021	.0048	.0066	.0026	.0041
PHASE ANGLE =	86.9	256.3	272.3	312.8	340.9	82.0	197.0	141.2
RADIUS = .350								
AMPLITUDE =	.0025	.0030	.0027	.0016	.0038	.0048	.0021	.0032
PHASE ANGLE =	95.2	262.3	265.6	312.2	335.8	80.4	191.8	141.1
RADIUS = .400								
AMPLITUDE =	.0017	.0021	.0020	.0010	.0027	.0027	.0016	.0022
PHASE ANGLE =	112.8	274.0	254.0	313.2	325.6	76.5	181.7	140.6
RADIUS = .500								
AMPLITUDE =	.0011	.0012	.0011	.0003	.0015	.0005	.0010	.0006
PHASE ANGLE =	173.7	315.4	220.5	5.4	287.5	322.8	145.8	135.5
RADIUS = .600								
AMPLITUDE =	.0011	.0011	.0006	.0007	.0014	.0017	.0010	.0003
PHASE ANGLE =	214.9	351.3	181.8	69.5	257.0	274.6	106.6	341.1
RADIUS = .700								
AMPLITUDE =	.0006	.0005	.0005	.0016	.0014	.0010	.0011	.0003
PHASE ANGLE =	302.9	2.3	20.3	45.1	284.5	265.3	86.5	344.3
RADIUS = .800								
AMPLITUDE =	.0008	.0006	.0011	.0018	.0015	.0002	.0009	.0002
PHASE ANGLE =	337.2	271.9	358.0	52.2	301.0	227.4	89.6	41.3
RADIUS = .900								
AMPLITUDE =	.0005	.0020	.0012	.0015	.0011	.0001	.0007	.0005
PHASE ANGLE =	252.0	266.3	331.1	109.6	290.6	114.7	137.4	73.3
RADIUS = 1.000								
AMPLITUDE =	.0016	.0033	.0012	.0026	.0008	.0001	.0011	.0008
PHASE ANGLE =	206.5	269.1	298.4	152.3	251.6	12.8	179.7	77.3

TABLE H-5 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE EXPERIMENTAL RADII FOR EXPERIMENT 16

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .456								
AMPLITUDE =	.1958	.0033	.0058	.0001	.0003	.0006	.0010	.0014
PHASE ANGLE =	182.2	77.3	9.2	194.6	135.0	200.4	285.2	287.0
RADIUS = .633								
AMPLITUDE =	.1761	.0026	.0034	.0005	.0005	.0010	.0012	.0005
PHASE ANGLE =	181.9	301.3	7.9	103.0	98.9	109.4	344.0	86.3
RADIUS = .781								
AMPLITUDE =	.1654	.0033	.0027	.0011	.0005	.0002	.0012	.0006
PHASE ANGLE =	181.0	61.6	10.3	238.4	306.7	166.4	330.8	107.4
RADIUS = .963								
AMPLITUDE =	.1607	.0045	.0010	.0023	.0002	.0005	.0002	.0011
PHASE ANGLE =	181.6	291.7	107.0	100.8	176.4	342.8	98.1	192.2

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .456								
AMPLITUDE =	.0027	.0008	.0009	.0012	.0009	.0008	.0010	.0009
PHASE ANGLE =	15.5	352.0	148.5	107.7	208.4	272.7	309.1	319.3
RADIUS = .633								
AMPLITUDE =	.0003	.0004	.0001	.0004	.0009	.0005	.0001	.0004
PHASE ANGLE =	161.6	35.1	58.4	55.8	346.0	215.4	232.0	32.7
RADIUS = .781								
AMPLITUDE =	.0010	.0004	.0003	.0005	.0005	.0003	.0002	.0005
PHASE ANGLE =	169.9	158.7	17.7	337.7	23.5	83.1	11.3	238.0
RADIUS = .963								
AMPLITUDE =	.0012	.0003	.0013	.0013	.0002	.0007	.0003	.0002
PHASE ANGLE =	162.5	68.1	142.[illegible]	243.2	231.5	197.7	53.9	356.6

TABLE H-6 - HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS AT THE INTERPOLATED RADII FOR EXPERIMENT 16

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	1	2	3	4	5	6	7	8
RADIUS = .312								
AMPLITUDE =	.2173	.0170	.0040	.0022	.0012	.0031	.0026	.0043
PHASE ANGLE =	182.0	90.2	10.8	256.2	268.1	252.5	240.5	280.7
RADIUS = .350								
AMPLITUDE =	.2111	.0126	.0060	.0015	.0007	.0022	.0020	.0034
PHASE ANGLE =	182.1	83.2	10.4	255.3	261.4	248.2	246.6	281.6
RADIUS = .400								
AMPLITUDE =	.2036	.0076	.0069	.0007	.0003	.0013	.0014	.0024
PHASE ANGLE =	182.2	86.6	9.8	251.7	230.4	236.9	259.9	283.4
RADIUS = .500								
AMPLITUDE =	.1902	.0012	.0051	.0003	.0005	.0006	.0009	.0008
PHASE ANGLE =	182.2	38.0	8.7	98.7	116.3	150.4	309.3	293.5
RADIUS = .600								
AMPLITUDE =	.1792	.0025	.0038	.0006	.0006	.0010	.0011	.0003
PHASE ANGLE =	182.0	300.4	7.9	96.4	103.1	112.2	340.8	73.4
RADIUS = .700								
AMPLITUDE =	.1705	.0019	.0033	.0007	.0002	.0006	.0013	.0006
PHASE ANGLE =	181.4	41.6	7.6	237.6	344.5	126.6	335.5	91.3
RADIUS = .800								
AMPLITUDE =	.1645	.0032	.0025	.0010	.0005	.0002	.0011	.0006
PHASE ANGLE =	181.0	60.9	11.7	235.0	304.1	183.6	330.3	113.8
RADIUS = .900								
AMPLITUDE =	.1613	.0016	.0012	.0008	.0003	.0003	.0005	.0007
PHASE ANGLE =	181.1	357.1	37.2	136.5	284.3	313.1	335.2	165.4
RADIUS = 1.000								
AMPLITUDE =	.1607	.0045	.0010	.0023	.0002	.0005	.0002	.0011
PHASE ANGLE =	181.6	291.7	107.0	100.8	176.4	342.8	98.1	192.2

TABLE H-6 (Continued)

VELOCITY COMPONENT RATIOS FOR MODEL 5271 BASS BOAT ONLY 10 INC 3KTSW016
PROPELLER DIAMETER = 6.00 FEET JA = .739

HARMONIC ANALYSES OF TANGENTIAL VELOCITY COMPONENT RATIOS (VT/V)

HARMONIC =	9	10	11	12	13	14	15	16
RADIUS = .312								
AMPLITUDE =	.0068	.0010	.0022	.0022	.0041	.0016	.0026	.0025
PHASE ANGLE =	15.1	321.1	146.6	117.0	185.7	314.9	318.9	283.0
RADIUS = .350								
AMPLITUDE =	.0055	.0010	.0018	.0019	.0031	.0013	.0021	.0020
PHASE ANGLE =	15.1	329.5	147.2	115.2	188.1	306.1	317.2	288.6
RADIUS = .400								
AMPLITUDE =	.0041	.0009	.0014	.0016	.0019	.0010	.0015	.0014
PHASE ANGLE =	15.1	340.4	147.9	112.3	193.5	291.7	314.2	299.4
RADIUS = .500								
AMPLITUDE =	.0017	.0007	.0006	.0010	.0005	.0007	.0006	.0007
PHASE ANGLE =	16.4	.8	148.5	102.2	247.9	257.2	302.5	341.3
RADIUS = .600								
AMPLITUDE =	.0002	.0004	.0001	.0005	.0008	.0005	.0002	.0005
PHASE ANGLE =	64.8	23.5	130.2	74.8	339.2	225.7	261.7	24.9
RADIUS = .700								
AMPLITUDE =	.0007	.0002	.0003	.0005	.0007	.0001	.0001	.0002
PHASE ANGLE =	169.4	130.8	18.9	10.1	3.9	123.7	325.5	260.7
RADIUS = .800								
AMPLITUDE =	.0010	.0005	.0002	.0006	.0005	.0004	.0002	.0005
PHASE ANGLE =	169.6	159.3	18.5	329.2	27.4	84.7	16.2	237.7
RADIUS = .900								
AMPLITUDE =	.0012	.0003	.0005	.0008	.0001	.0003	.0003	.0003
PHASE ANGLE =	166.3	141.3	191.4	271.4	42.2	150.0	38.5	250.4
RADIUS = 1.000								
AMPLITUDE =	.0012	.0003	.0013	.0013	.0002	.0007	.0003	.0002
PHASE ANGLE =	162.5	66.1	192.6	243.2	231.5	197.7	53.9	356.8

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1. DTNSRDC REPORTS, A FORMAL SERIES, CONTAIN INFORMATION OF PERMANENT TECHNICAL VALUE. THEY CARRY A CONSECUTIVE NUMERICAL IDENTIFICATION REGARDLESS OF THEIR CLASSIFICATION OR THE ORIGINATING DEPARTMENT.

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